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ANNUAL REPORT
OF THE
State Engineer and Surveyor
ON THE
CANALS OF NEW YORK,
FOR THE
Fiscal Year Ending September 30, 1885.

TRANSMITTED TO THE LEGISLATURE JAN. 26, 1886.

ALBANY:
THE ARGUS COMPANY, PRINTERS.
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STATE OF NEW YORK.

No. 44.

IN ASSEMBLY,

JANUARY 26, 1886.

REPORT
OF THE
STATE ENGINEER AND SURVEYOR.

OFFICE OF THE STATE ENGINEER AND SURVEYOR, }
ALBANY, N. Y., *January 25, 1886.* }

HON. JAMES W. HUSTED,

Speaker of the Assembly:

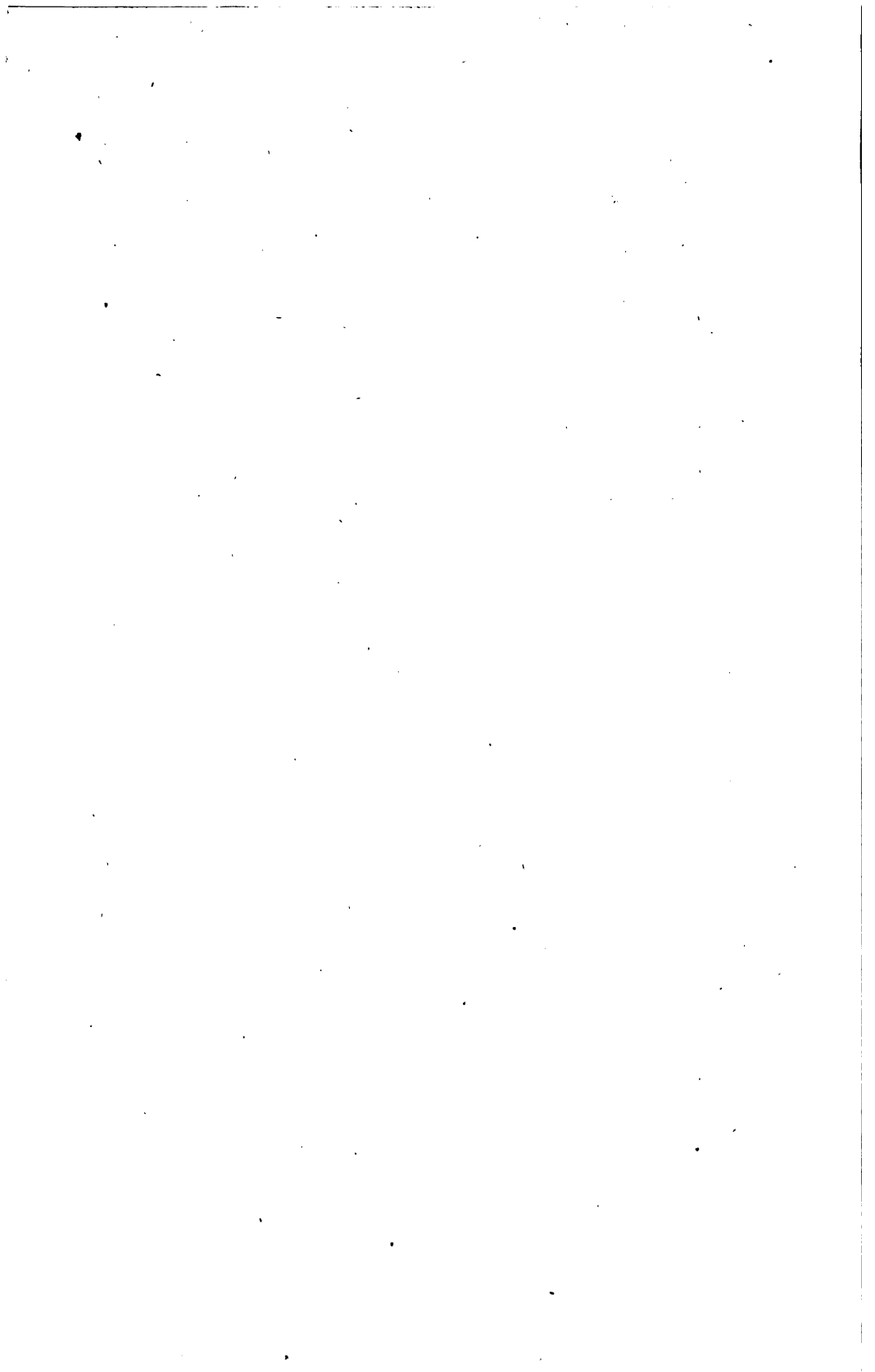
SIR.—I have the honor to submit herewith my Annual Report relative to the Canals of the State for the fiscal year ending September 30, 1885.

Very respectfully,

Your obedient servant,

E. SWEET,
State Engineer and Surveyor.

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REPORT.

STATE OF NEW YORK:

OFFICE OF THE STATE ENGINEER AND SURVEYOR, }
ALBANY, January 26, 1886. }

To the Honorable the Legislature of the State of New York:

In compliance with law I have the honor to submit the following report of this department for the past year:

OPERATIONS OF THE CANALS.

The worst effects of the depression of business have, during the past season, been visited upon the great transportation interests of the country. They have performed the worst recompensed service they have ever done heretofore. The tonnage of the canal has only reached an aggregate of 4,731,784 tons, or 277,504 tons less than that of last year, and the rate of freight has fallen from 27-100 of a cent per ton per mile last year to 23-100 of a cent per ton per mile this year. The aggregate tonnage of the New York Central and Erie railroads, the chief competitors for the business done by the canals this year, shows a diminution of 1,052,499 tons, and the average rate of freight on these roads has fallen from 74-100 of a cent per ton per mile in 1884 to 67-100 of a cent per ton per mile in 1885.

I present below a table showing the tonnage of the State canals and of the railroads competing with them for the period of twenty-four years which have elapsed since the enlargement of the Erie canal.

Years.	Canals—Tons.	Railroads—Tons.
1862	5,598,785	3,020,388
1863	5,557,692	3,264,700
1864	4,852,941	3,727,946
1865	4,729,654	3,609,640
1866	5,775,220	4,844,989
1867	5,688,325	5,152,472
1868	6,442,225	5,754,842

Years.	Canals—Tons.	Railroads—Tons.
1869	5,859,080	6,594,094
1870	6,173,769	8,974,505
1871	6,467,888	9,376,264
1872	6,673,370	9,958,239
1873	7,364,782	11,835,426
1874	5,804,588	12,478,954
1875	4,859,858	12,241,900
1876	4,172,129	12,776,498
1877	4,955,963	12,533,807
1878	5,171,320	13,845,981
1879	5,362,372	17,228,394
1880	6,457,652	19,248,930
1881	5,179,192	22,678,202
1882	5,467,423	23,225,631
1883	5,664,056	24,503,063
1884	5,009,488	22,123,895
1885	4,751,784	21,071,446

On account of the shorter haul of the railroad freights the railroad tonnage should be divided by two in order to obtain a just comparison with the work done by the rival systems, and an examination of the railroad reports and the canal statistics for the year will show that the volume of through tonnage by these routes and by the canal has been nearly equal.

NAVIGATION.

The canals were opened on the 11th day of May and closed on the 1st day of December, 1885. There have been no considerable breaks nor any serious obstruction to the use of the canals, giving, perhaps, the first example during their history of an uninterrupted season of navigation.

CONDITION OF THE CANALS.

Though in respect to the tow-path, the bridges and the locks, the condition and efficiency of the canals has been maintained and improved, the appropriations for their maintenance has not been sufficient to enable the Superintendent of Public Works to undertake, as he has desired and as the interests of navigation require, the removal of the sediment that has been accumulating in many parts of the canal prisms since its enlargement, nor to make all needed repairs to important structures. The most serious of the accumulations of silt in the prism of the canal are between Lock-

port and Montezuma, and, in my opinion, it would be wise action on the part of the Legislature to provide means for the restoration of this part of the canal to its original dimensions. This work involves the excavation and removal of about 400,000 cubic yards of material, and will probably cost \$100,000. I believe there remains in the treasury unexpended balances of former appropriations for the ordinary repair of the canals sufficient in amount to accomplish this object, which might be set apart for that purpose. The importance of removing this accumulated sediment has long been felt and should not be deferred. It retards the flow of water and passage of boats and has become the feeding grounds of a mass of aquatic vegetation which has to be frequently cut or uprooted, at a great expense, in order to permit the proper flow of water through this part of the canal, all of which is fed from the western end at Lake Erie.

There are many important structures of which the perishable portions need immediate attention, notably the wooden trunks of most of the great aqueducts and the cribs and aprons of many dams which make it essential to the security of navigation that adequate appropriations be made for the maintenance and operation of the canals.

IMPROVEMENTS SUGGESTED.

There are two special works of improvement which can be compassed within moderate limits of expense which seem to me worthy of consideration by the Legislature.

First. The completion of the reservoir at Forestport for increasing and hastening the supply of water to the Rome level of the Erie canal; \$20,000 was appropriated for this object in 1883, which was only sufficient to prepare the site and provide part of the materials for building it. It is estimated that an additional sum of \$45,000 will be required to complete it. The speedy completion of this reservoir is essential to a safe and certain supply of water to this part of the canal, as the experience of every dry season in recent years has fully demonstrated, and it will become of still greater importance if the projected improvement of lengthening the locks should be carried out, as more feed water will then be required.

Second. The success attending the operation of the newly lengthened lock at Geddes makes it quite clear that the lengthen-

ing of the five locks, numbered 47, 48, 49, 51 and 52, which have an upward lift going east, would be a most desirable improvement.

The importance of applying this improvement to these particular locks arises from the practice, which has been found very economical and has recently become almost universal, of towing two boats together, one coupled behind the other. These boats when moving east are always loaded, and in approaching and entering the locks above mentioned — which have their upward lift to the eastward — they encounter so strong a current as to make great delay and trouble in separating the coupled boats and getting them into and through the locks. All the other locks of the Erie canal descend eastward and present no such difficulty, because the boats which move westward against the current are always light, or partly loaded, and are, therefore, readily towed against the current, and the heavily loaded boats moving east are helped by the current into and through the locks. The probable cost of lengthening these five locks and applying machinery for assisting boats through them will be in detail as follows:

For lengthening lock No. 47.....	\$35, 000
For lengthening lock No. 48.....	35, 000
For lengthening lock No. 49.....	26, 000
For lengthening lock No. 51.....	27, 000
For lengthening lock No. 52.....	41, 000
Add for contingencies.....	16, 000

Makes total estimate cost.....	<u>\$180, 000</u>
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IMPROVEMENTS EXECUTED OR IN PROGRESS.

Since my last report the following works have been undertaken or finished, under special appropriation, by Laws of 1884 and 1885. Iron bridges have been built at Medina, Watervliet, Whitehall and Herkimer, and those authorized at Rochester and West Troy, and the dam on the Beaver river are in progress of construction. The two viaducts across the Chenango canal in the city of Utica, the iron culvert under the Erie canal for the drainage of Miller's basin in Utica, and a heavy sea wall at Buffalo, authorized by the Laws of 1885, have been completed in a satisfactory manner and within the limits of cost provided by the legislative appropriations therefor. Nearly all the improvements of the Champlain canal undertaken under chapter 301 of the Laws of 1884,

have been completed during the fiscal year, the contracts therefor settled and terminated. These Champlain improvements consisted in the building of eight new bridges, fourteen bridge abutments, three stone culverts, five waist-weirs and one spillway of first-class masonry, important repairs to three locks and the widening, straightening and strengthening of nearly five miles of the canal structure. The total cost of those finished has been \$163,603.99, which is less by over \$15,000 than their estimated cost when undertaken. There remain unfinished four or five unimportant pieces of prism work, upon which a little over \$2,000 has been expended and which will require about \$10,000 to complete, which sum has already been set aside for the purpose of the Canal Board. Full details of these improvements will be found in the annexed report of the division engineer of the Eastern Division.

SURVEYS.

It seems fit that as the legal custodian of the engineering records of the State I should call your attention to the importance of providing for the preservation in this office of the notes, maps, records and other results of the defunct State and Adirondack surveys. I believe that a very considerable amount of office work is requisite to reduce the results and notes of those surveys to available form, and that some field-work is needed for the proper preservation of their signals, and I would respectfully suggest that some provision be made therefor. I am of the opinion that before the great work of a topographical survey of the State is again undertaken in earnest, the subject should be exhaustively examined by competent persons, a definite and comprehensive plan devised and formulated, and careful estimates made of its probable cost, in order that the Legislature and the people may have an intelligent basis of action. One branch of the subject, however,—the survey of the State lands in the forest districts—is now urgent. Definitely fixing and permanently marking these boundaries is an essential preliminary to any intelligent work of State forestry.

I also renew my recommendation of last year that thorough surveys be made to determine the best means and probable cost of carrying out the plan of a radical improvement of our canals as outlined by me in my annual report of last year.

THE ENGINEERING DEPARTMENT.

The operations and expenses of the engineers employed in this department will be found detailed in the accompanying reports of the several division engineers. The following is a summary of these expenses. I also append hereto the table showing the cost of constructing and maintaining the several canals built by the State from their inception to the present time.

Respectfully submitted,

E. SWEET,
State Engineer and Surveyor.

*SUMMARY of Engineering Expenses for the New York State
canals for the fiscal year ending September 30, 1885.*

For ordinary repairs, Eastern Division.....	\$8,961 21
For ordinary repairs, Middle Division.....	6,948 05
For ordinary repairs, Western Division.....	6,838 40

Total for ordinary repairs.....	<u>\$22,747 66</u>
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For extraordinary repairs, Eastern Division.....	\$12,108 52
For extraordinary repairs, Middle Division.....	1,452 01
For extraordinary repairs, Western Division.....	1,916 15

Total for extraordinary repairs.....	<u>\$15,476 68</u>
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The aggregate expenses for the engineering work of the Hudson river improvement for the calendar year ending January 1, 1886, have been.....	<u><u>\$3,818 38</u></u>
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TABLE showing the total cost for construction, maintenance and operation of the several State canals and their total revenues from their inception to 1886.

	Total cost for construction, maintenance and operation.	Total revenues from all sources.
Erie and Champlain canals.	\$94,040,407 63	\$130,930,993 37
Oswego canal.....	8,043,706 18	3,717,906 93
Cayuga and Seneca canals.	3,005,650 31	1,054,800 15
Black River canal.....	5,590,642 55	305,525 54
Genesee Valley canal.....	9,569,948 52	859,612 30
Chemung canal.....	3,427,298 98	525,425 97
Chenango canal.....	6,880,675 27	740,717 06
Oneida river improvement.	263,242 80	217,061 34
Oneida Lake canal.....	580,626 05	65,188 47
Baldwinsville canal.....	39,519 94	1,261 48
Crooked Lake canal.....	821,271 13	45,352 71
	<u>\$132,523,998 56</u>	<u>\$138,463,845 32</u>

The above statements of cost do not include the sums paid for interest on canal loans which have been supplied by the surplus canal revenues and by taxation.

There has been raised by direct taxes for canals..	\$43,108,316 53
There has been raised by indirect taxes for canals.....	5,721,007 10

Total by taxes.....	\$48,829,323 63
The canal revenues have been applied to general purposes of the State government to the extent of.....	18,850,411 94

Leaving of State revenues applied to canals..	\$29,978,911 69
At the beginning of 1885 there remained of the canal debt, less sinking fund.....	4,837,680 63

Leaving net loss through the canals.....	<u>\$34,816,592 32</u>
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EASTERN DIVISION.

ANNUAL REPORT OF THE DIVISION ENGINEER, NEW YORK STATE
CANALS, FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1886.

HON. E. SWEET,

ALBANY, *October 1, 1886.*

State Engineer and Surveyor :

SIR.—I have the honor to transmit herewith my annual report for the fiscal year ending September 30, 1886.

Yours respectfully,

JOHN R. KALEY,

Division Engineer.

DESCRIPTION OF THE EASTERN DIVISION.

The limits of this division remain as fixed by the Canal Board in February, 1876. It embraces the Erie canal from Albany to the East end of Oneida county, and the whole of the Champlain canal, including their basins, side-cuts, river improvements and feeders.

The canal is entered from the river at its terminus through lock No. 1, also by two side-cuts, one at Port Schuyler and the other at West Troy; the connection at Albany and West Troy being with double locks, and at Port Schuyler by single lock.

This division also embraces the Champlain canal, from its junction with the Erie at West Troy, to Whitehall, together with the Glens Falls feeder, from where it joins the Champlain, one mile north of Fort Edward to the feeder-dam in the Hudson river, two miles west of Glens Falls, including also the pond extending five miles above this point, together with the pond above the Troy dam, and the Waterford side-cut.

The Champlain canal is entered from the Erie at West Troy, and from the pond in the Hudson at Waterford through the side-cut.

The number of miles of navigable canals and river improvements on the Eastern Division is as follows :

	Miles.
Erie canal, Albany to east line of Oneida county.....	106.243
Port Schuyler side-cut.....	.35
Albany basin.....	.77
Champlain canal, including Waterford side-cut and Cohoes and Saratoga dams.....	66
Pond above Troy dam.....	3
Glens Falls feeder and pond.....	12
Total.....	188.363

Extent of Feeders not navigable.

	Miles.
Mohawk river at Rexford Flats.....	.39
Mohawk river, south side, Little Falls.....	.19
Mohawk river at Rocky Rift.....	3.92
Schoharie creek.....	.63
Total.....	<u>5.13</u>

ERIE CANAL -- WATER SUPPLY.

The Erie canal upon this division is supplied with water from the following sources:

That portion of this division west of Little Falls is supplied from reservoirs and streams on the Middle Division, through the Rome level. At Little Falls the supply is through the feeder from the Mohawk river, entering the canal through the tow-path, about sixty feet below lock No. 39.

Near Mindenville the supply is through Rocky Rift feeder from the Mohawk river, discharging into the canal through the tow-path, four hundred feet below lock No. 34.

Near Fort Hunter the supply is from Schoharie creek, discharging into the canal on the berme side about 400 feet below lock No. 29.

At Rexford Flats the supply is from the Mohawk river, entering the canal through the tow-path, about 120 feet below lock No. 21.

The water supply on this division of the Erie canal has been uniformly good, and the levels kept fully up to their proper elevation.

CHAMPLAIN CANAL -- WATER SUPPLY.

The water supply of the Champlain canal is principally from the Hudson river through the Glens Falls feeder, discharging into the summit level of the Champlain canal, supplying the canal from Northumberland to Whitehall, being supplemented on the north by waters of Wood creek. Also from Northumberland to the first lock North of Waterford, the supply is from the Hudson river, entering the canal at Northumberland, and from the last-mentioned lock on the Erie canal, including the Waterford side-cut, the supply is from the Mohawk river. The water supply on this canal during the past year has been ample.

The Eastern Division of the Erie canal is divided into four sections as follows:

Section No. 1 includes that portion of the Erie canal extending from Albany to the lower Mohawk aqueduct, including the Albany basin, the Port Schuyler and West Troy side-cuts and the Champlain canal from Cohoes to its junction with the Erie.

Section No. 2 extends from the lower Mohawk aqueduct to lock No. 27.

Section No. 3 extends from lock No. 27 to lock No. 34.

Section No. 4 extends from lock No. 34 to the east line of Oneida county.

ALBANY BASIN.

By act chapter 200, Laws of 1849, this basin was transferred to the State "on payment to the city of Albany the sum of \$121,462.63, and interest from February 20, 1843, at six per cent; in consideration of the expenses incurred by the said city for excavating and cleaning out the basin opposite the same at the termination of the Erie canal," "and to the owners of the pier connected with said basin a further sum of \$30,000 in lieu of tolls heretofore received by them."

The State has expended a large amount of money for dredging out the basin.

By acts of the Legislature of 1835, 1836 and 1837, various improvements were made by the State and city of Albany, the basin being at that time a great factor in the transfer of grain and other commodities, but since the erection of several railroad bridges it has been but little more than an harbor for steam and canal boats and an outlet for the sewer system of the city, which annually causes large deposits to accumulate. (See reports of State Board of Health for 1884.) I would recommend that legislative action be taken to prevent further accumulation of said sewerage matter.

I would also recommend that a wing crib or pier be constructed at such an angle, at the north cut, or entrance to the basin at lock No 1 that would turn the river current away from the basin and prevent the annual deposit of silt and saw-dust at the entrance of the lock, which has to be removed before the commencement of navigation on the Erie canal.

ERIE CANAL — LOCKS.

There are forty-seven double locks on this division of the Erie canal, two of which are on the West Troy side-cut, also two single locks combined on the Port Schuyler side-cut, the two last mentioned connecting the canal with the Hudson river at these points. There are also two weigh-locks located at West Troy and Albany. All are enlarged, being 110 by 18 feet each in the chamber, with various lifts as shown by the accompanying table. The forty-five locks situated on the main canal from Albany to the east line of Oneida county have a total lift of 425.4 feet above tide-water.

Locks 37 and 44 have tumble gates at the upper end; lock No. 39 has a tumble gate in berme-lock; the rest all have mitre gates. Those of lock No. 37 are all operated by water-power machinery; also the tumble gates in locks Nos. 39 and 44.

NUMBER.	DISTANCES.		Lift in feet.
	Lock to Lock.	From Albany.	
1.....	.....	.....	15.159
2.....	98 chains 83 links	1.24 miles	9.495
3.....	419 chains 16 links	6.48 miles	11.169
3.....	25 chains 17 links	6.80 miles	11.380
4.....	21 chains 90 links	7.07 miles	10.597
5.....	16 chains 52 links	7.28 miles	10.073
6.....	10 chains 61 links	7.41 miles	9.931
7.....	12 chains 86 links	7.57 miles	10.545
8.....	26 chains 53 links	7.90 miles	9.408
9.....	14 chains 58 links	8.08 miles	10.362
10.....	12 chains 91 links	8.24 miles	9.621
11.....	11 chains 66 links	8.39 miles	9.986
12.....	16 chains 5 links	8.59 miles	10.345
13.....	17 chains 9 links	8.80 miles	10.032
14.....	21 chains 53 links	9.07 miles	9.833
15.....	15 chains 20 links	9.26 miles	10.045
16.....	25 chains 39 links	9.58 miles	10.287
17.....	15 chains 44 links	9.77 miles	10.249
18.....	708 chains 42 links	18.63 miles	8.441
19.....	219 chains 29 links	21.37 miles	10.418
20.....	257 chains 90 links	24.59 miles	11.126
21.....	14 chains 1 link	24.77 miles	11.609
22.....	553 chains 43 links	31.69 miles	8.318
23.....	63 chains 7 links	32.47 miles	7.326
24.....	303 chains 87 links	36.27 miles	8.581
25.....	510 chains 59 links	42.66 miles	8.365
26.....	16 chains 8 links	42.86 miles	7.886
27.....	417 chains 16 links	48.07 miles	7.723
28.....	157 chains 20 links	50.04 miles	7.399
29.....	50 chains 60 links	50.67 miles	10.213
30.....	1108 chains 34 links	64.52 miles	5.867
31.....	505 chains 62 links	70.84 miles	8.126
32.....	408 chains 77 links	75.95 miles	5.704
33.....	205 chains 63 links	78.52 miles	8.483
34.....	254 chains 23 links	81.70 miles	7.785
35.....	349 chains 20 links	86.07 miles	10.019
36.....	49 chains 52 links	86.68 miles	9.898
37.....	12 chains 87 links	86.85 miles	8.733
38.....	17 chains 35 links	87.06 miles	10.524
39.....	220 chains 82 links	89.82 miles	8.524
40.....	211 chains 11 links	92.46 miles	8.286
41.....	228 chains 99 links	95.32 miles	7.954
42.....	20 chains 59 links	95.58 miles	8.069
43.....	216 chains 16 links	98.28 miles	10.737
44.....	98 chains 62 links	99.52 miles	11.172
45 to county line..	537 chains 67 links	106.24 miles	.....

The locks of this division are for the greater part in good condition and need very little repairs.

The most important recommendation I have to make is, that where needed they should be thoroughly pointed with Portland cement; the joints being well cleaned and the cement well caulked in the joints.

A brief description is given below of what has been done during the past year and what is necessary to be done to place the locks of this division in good working order.

Lock No. 1. Needs two upper gates; lock also needs repointing.

Lock No. 2. Masonry should be pointed.

Lower side-cut lock, West Troy. Needs one lower gate.

Lock No. 3. The right lock, going west, needs a set each of upper and lower gates; also needs repointing.

Lock No. 4. There is considerable leakage through the bottom of this lock; it should be carefully examined and all places where leakage occurs concreted; walls need repointing.

Lock No. 5. In fair condition; some repointing needed.

Lock No. 6. One pair of lower gates in the right hand, and one upper in the left locks, have been removed; lock needs repointing.

Lock No. 7. The right lock has given much trouble this year, caused by the settling of the west wall near the center of the lock, allowing the water to leak through into the culvert. An examination showed that the foundation at this point was puddle, the balance on each side being concrete. The puddle cut away and allowed the wall to settle; the joint above the bottom course opened four inches. The culvert masonry between the locks has settled about eight inches, the side-walls and intrados being out of line to that extent. From all appearances this settling took place a long time ago, as the joints are plugged with wood, which had been there for a long time. I do not consider the masonry in a dangerous condition. The leakage through the side wall has been thoroughly stopped. The upper gate in the right-hand lock has been renewed.

Lock No 8. In good condition. The lower gates in the left-hand lock have been renewed.

Lock No. 9. In good condition.

Lock No. 10. In good condition.

Lock No. 11. The bottom course of the left hand wall of the right lock, near the head, has settled and crowded into the chamber about two inches; this extends twenty feet towards the lower gates; the joint opened one inch. This foundation is supposed to be on rock bottom. Much difficulty was experienced in making temporary repairs as there is about eighteen inches of water in the chamber when the lower level is drawn. I would recommend that at the close of navigation the water be pumped out of the chamber, the bottom be taken up, and thorough repairs be made.

Lock No. 12. In fair condition; some repointing needed.

Lock No. 13. In fair condition ; some repointing needed.

Lock No. 14. Two upper gates and right lock should be renewed, also two lower ones ; walls need repointing.

Lock No. 15. The breast walls of this lock need repairs ; there is much leakage through the walls, rendering it difficult to work the wickets ; one upper gate in the right-lock has been renewed.

Lock No. 16. The breast wall of this lock are in the same condition as No. 15 ; one lower gate in the right lock has been renewed.

Lock No. 17. This structure is in good repair ; one pair of upper gates in the right lock and one lower in the left-hand lock have been renewed ; the bulk-head at the head and foot of this lock should be refilled to the level of the top timbers ; the filling has settled from two to three feet, rendering it dangerous for boatmen and lock-tenders. This recommendation will apply to several other locks on the division.

Lock No. 18. The masonry of this lock is in good repair ; the upper gates of both locks should be renewed ; the docking running from the head of the lock on both sides is very much decayed ; I would recommend that the same be removed and a vertical wall in cement constructed.

Section No. 2.

Lock No. 19. Is in good condition ; masonry needs pointing, and new bulk-head needed at the head of the lock.

Lock No. 20. Is in good condition ; some repointing needed.

Lock No. 21. One pair of lower gates in the right lock have been removed ; masonry needs pointing.

Lock No. 22. One upper gate in the right lock has been removed ; masonry needs pointing.

Lock No. 23. One pair of upper gates in the left-hand lock have been removed ; masonry needs pointing.

Lock No. 24. Masonry needs pointing ; new bulk-head should be built at the head of the lock ; the right lock should have a new bottom.

Lock No. 25. Two upper gates in the right lock have been renewed ; the lower gates in the same lock should be new ; bulk-head should be rebuilt at head of lock.

Lock No. 26. Two upper gates in the right lock have been renewed.

Section No. 3.

Lock No. 27. Two upper gates in the right, and two lower in the left lock have been renewed. Masonry needs pointing. Left lock should have a new bottom. Lower gates in left lock should be new also. Bulk-head.

Lock No. 28. The left lock needs new lower gates, and the right lock new upper gates. Masonry should be pointed.

Lock No. 29. The right lock needs new lower gates. Masonry should be pointed and the east ends of the feeder wall should be relaid.

Lock No. 30. Masonry needs pointing.

Lock No. 31. Masonry should be pointed.

Lock No. 32. The well walls of the left lock have bulged in so badly, that large boats wedge fast, and cases have occurred where it was found necessary to pass boats through the right lock. Masonry should be pointed.

Lock No. 33. Masonry in good condition; should be pointed.

Section No. 4.

Lock No. 34. The bottom of the left lock needs repairs. The two upper gates in the right lock should be renewed. Masonry needs pointing.

Lock No. 35. One upper gate in the left lock has been renewed. Masonry should be repointed.

Lock No. 36. Masonry should be pointed. I would recommend that another layer of plank be put on the bottom of the lock, at right angles to the present planking, some of the old planking being in bad repair.

Lock No. 37. Masonry needs pointing. Two lower gates in right lock have been renewed.

Lock No. 38. Masonry should be pointed and bottom of lock replanked.

Lock No. 39. One lower gate in the left lock has been renewed. Masonry should be pointed. The walls are slightly bulged in. Some stone are out at head of the right lock.

Lock No. 40. Masonry needs slight repairs.

Lock No. 41. Masonry should be pointed. The lock chamber cannot be drained; there is fifteen inches of water over the lower sill when the level is empty.

Lock No. 42. One lower gate in the left lock has been renewed. Masonry needs pointing. The apron at the foot of the lock needs refilling and new planking.

Lock No. 43. Masonry needs pointing.

Lock No. 44. The masonry of this lock should be repointed. The bevel in the chamber at the foot of the left lock should be cut off; boats drag on it and have much trouble passing through. This bevel was partially cut off some years ago, but the work was not properly done.

Lock No. 45. The left wall of the right lock has settled badly. Some of the masonry under the bucking-beam at the head of the right lock is out and should be relaid. The lock walls need repointing. One new bucking-beam is needed.

ERIE CANAL — DAMS.

There are four dams on this division of the Erie canal; a full description of each is given in my report of last year.

Section No. 1.

There are no dams on this section.

Section No. 2.

No. 1. Located at Rexford Flats across the Mohawk river. This dam is in good condition. The feeder bulk-head at the arch passing under the canal has been repaired.

Section No. 3.

No. 2. Located near Fort Hunter, across Schoharie creek. The crib-work and covering of this dam are much worn and should be repaired. There is a large amount of leakage through this structure.

No. 3. Located five miles east of Little Falls, across the Mohawk river, known as Rocky Rift feeder dam. I would renew my recommendation of last year, that the masonry of this structure be raised.

Section No. 4.

No. 4. At Little Falls, across the Mohawk river. This is an old and dilapidated structure; its care is a source of much labor and expense. There is also a large waste of water through the structure. I would renew my recommendation of last year, that the structure be rebuilt of stone.

ERIE CANAL — AQUEDUCTS.

There are sixteen aqueducts on this division of the Erie canal. A description is given in the accompanying table.

AQUEDUCTS—ERIE CANAL.

Number.	NAME.	Location Distance West of Lock.	Interior width.	Number of spans.	Total length.
1	Lower Mohawk.....	220 chains 52 links west of lock 18	40 ft. 6 in.	....	17 chains 23 links.
2	Upper Mohawk.....	6 chains 60 links west of lock 22	44 ft. 4 in.	....	9 chains 25 links.
3	Flat Stone Creek.....	113 chains 97 links west of lock 24	.....	3	1 chain 13 links.
4	Sansai Creek.....	171 chains 9 links west of lock 25	52 ft.....	4	1 chain 55 links.
5	Schoharie Creek.....	8 chains 97 links west of lock 30	40½ ft.....	14	9 chains 46 links.
6	Tokkon Creek.....	664 chains 91 links west of lock 30	51½ ft.....	4	1 chain 53 links.
7	Leonardson Creek.....	846 chains 38 links west of lock 30	51 ft.....	4	1 chain 53 links.
8	Leonardson Creek.....	934 chains 92 links west of lock 30	50 ft.....	3	1 chain 13 links
9	Platt Kill.....	5 chains 77 links west of lock 31	50 ft.....	5	1 chain 94 links.
10	Bowman's Creek.....	251 chains 97 links west of lock 31	.....	5	1 chain 94 links.
11	Otsuago Creek.....	18 chains 31 links west of lock 32	.....	5	1 chain 91 links.
12	Castle Creek.....	7 chains 1 link west of lock 35	50½ ft.....	5	1 chain 94 links.
13	Fulmer's Creek.....	2 chains 72 links west of lock 43	65½ ft.....	3	1 chain 12 links.
14	Ilion Aqueduct.....	129 chains 36 links west of lock 43	51½ ft.....	2	74 links.
15	Meyer's Creek.....	2 chains 74 links west of lock 45	66 ft.....	2	74 links.
16	Ferguson's Creek.....	452 chains 35 links west of lock 45	57½ ft.....	1	33 links.

Section No. 2.

No. 1. Lower Mohawk aqueduct. The masonry is in good condition. The trunk was built in 1875 and is beginning to show signs of decay.

No. 2. Upper Mohawk aqueduct, between locks 22 and 23. The masonry is in good condition. The trunk was built in 1875 and is beginning to show signs of decay. Six of the thirteen ice-breakers have been protected by timber and plank, the remaining seven should be so protected.

No. 3. Flat Stone Creek aqueduct, known as Van Slyke's, between locks 24 and 25. The masonry is in good condition. The trunk needs slight repairs.

No. 4. Sansai Kill aqueduct between locks 25 and 26, known as Hoffman's aqueduct. The masonry on the berme side needs repairs. The creek channel above and below the aqueduct, and under the trunk, is badly filled up, reducing the water-way and endangering the structure.

Section No. 3.

No. 5. Schöharie creek aqueduct, between locks 30 and 31. The piers have been protected by rip-rap to prevent scouring and settling. Structure in good repair.

No. 6. Tokkon creek aqueduct, known as Van Wies', between locks 30 and 31. Is in good condition.

No. 7. Leonardson creek aqueduct, at Yatesville, known as Yatesville aqueduct, between locks 30 and 31. Is in good condition. The creek channel should be cleaned.

No. 8. Leonardson creek aqueduct, at Little Hose, known as Lashers', between locks 30 and 31. Is in good condition. The creek channel should be cleaned.

No. 9. Platt Kill aqueduct, at Spraker's Basin, between locks 31 and 32. The masonry is in good condition. The creek is filled up nearly to the bottom of the trunk, and requires much labor and expense each year to keep a sufficient opening to carry off the water. The trunk is removed at the close of navigation each year, to save it from being floated and destroyed.

No. 10. Bowman's creek aqueduct, at Canajoharie, between locks 31 and 32. The structure is similar to the last described. Several years ago the masonry was damaged by spring freshets and three of the piers were so much injured that the arches were taken down and the structure is supported by wooden bents placed on the piers. Those bents and the trunk have to be removed at the close of navigation for the same reason as stated in No. 9. A considerable degree of work is necessary here every year to keep the channel clear, as the opening between bed of creek and bottom of trunk is small.

No. 11. Otsquago creek aqueduct, also known as Fort Plain aqueduct, between locks 32 and 33. The masonry and trunk of

this structure are in good condition. Like Nos. 9 and 10 the trunk has to be removed during the cessation of navigation. The channel of the creek should be cleared.

Section No. 4.

No. 12. Castle creek aqueduct, between locks 35 and 36. The masonry is in good condition, and the trunk needs slight repairs. The channel of the creek below the aqueduct should be graded, so as to throw the water into the center of the creek bed; just below the aqueduct the water has formed two courses on the east and west sides of the channel, leaving a considerable island in the center. The effect of this is to throw the force of the stream on our side of its bed, where it flows over the culvert, through which the Rocky Rift feeder passes under this creek, and this is doing injury to the covering of the culvert. The channel of the creek above the aqueduct, or on the berme side of the canal, has been cleared, and the old docking, which was badly dilapidated, has been replaced for a portion of the way by a dry stone wall, and for the remainder by new docking.

No. 13. Fulmer's creek aqueduct, known as Mohawk aqueduct, between locks 43 and 44. The masonry and trunk of this structure are in good repair. About 65 feet of new vertical wall in cement, between this aqueduct and lock No. 43, has been recently built on the berme side.

No. 14. Steel's Creek aqueduct, known as Illion aqueduct, between locks 43 and 44. The masonry on berme side has been repaired, and structure is in good condition with the exception of coping of tow-path parapet, which is lacking.

No. 15. Myers' creek aqueduct, known as Frankfort aqueduct, between locks 45 and 46. This structure is in good condition, and only needs a small amount of clearing in channel, and slight repairs to trunk.

No. 16. Ferguson's creek aqueduct, between locks 45 and 46. This structure is in good condition, except a slight leak through masonry on berme side, which can probably be stopped by grouting and pointing when water is out of canal. The trunk needs slight repairs.

ERIE CANAL — WASTE-WEIRS AND SPILLWAYS.

Section No. 1.

No. 1. Wooden spillway over Patroons' creek culvert, between locks 1 and 2; berme side needs new planking and slight repairs to masonry.

No. 2. Waste-weir at Schenectady street bridge, West Troy, between locks 2 and 3; runs through the bridge and abutment, and has not been used for years.

No. 3. Spillway and waste-weir at West Troy, on berme side of canal, at upper end of the arsenal grounds; cut-stone structure,

with bulk-head and gates; thirty-three foot spillway, less ten posts of one foot each, and in fair condition.

No. 4. Spillway and waste-weir at West Troy, out of the Mohawk basin into the Hudson river; cut stone with bulk-head and gates; needs new bulk-head.

No. 5. Spillway and waste-weir, a short distance below lock No. 4, in tow-path, cut stone with breast wall of masonry; spillway, fifteen feet, is in fair condition. Masonry should be pointed.

No. 6. Spillway and waste-weir, six and one-half chains west of lock No. 9, in tow-path; cut stone with breast wall; spillway, fourteen feet six inches; masonry in lower wing displaced and needs pointing; wood work should be renewed.

No. 7. Spillway and waste-weir, a short distance above lock No. 18, in tow-path; cut-stone with timber bulk-head, has four gates; spillway, twenty-eight and one-half feet. This structure has a new bulk-head and gates.

Section No. 2.

No. 8. Spillway and waste-weir, about 400 feet above lock No. 20, in tow-path; is of cut stone; arch eight-foot chord and seventeen feet spillway. The masonry is in very bad condition and should be rebuilt from the foundation.

No. 9. Waste-weir and spillway, just west of Frog alley bridge, at Schenectady, in tow-path. This is an old cut-stone structure, with spillway about 120 feet long, which has been abandoned, but the bulk-head portion is still in use, with spillway of twelve feet. This structure should be rebuilt with a much shorter spillway, say of thirty feet.

Section No. 3.

No. 10. Waste-weir and spillway, about a quarter of a mile east of Port Jackson, in tow-path. This is a nearly new structure of wood and stone; bulk-head should be rebuilt; spillway, twelve feet; in good condition.

No. 11. Waste-weir with bulkhead, in the tow-path, about 725 feet east of lock No. 31; is a wooden structure, was rebuilt during year.

No. 12. Waste-weir of cut stone, with one gate, about three-quarters of a mile east of lock 33, on the tow-path side; was built about four years ago; it began to leak as soon as water was let into canal; was filled with gravel and abandoned. I would recommend that it be repaired and put in working order.

No. 13. Waste-weir with bulk-head, on the berme, about 100 feet west of lock No. 33.

No. 14. Wooden waste-weir, twenty-eight feet spillway, on tow-path about one-quarter of a mile west of lock 33. This structure was built about four years ago, it began to leak as soon as water was let into canal, and was filled up with gravel; has not been

used since. I would recommend that it be repaired and put in working order.

No. 15. Waste-weir and spillway, with culvert of four-foot chord of cut stone; spillway, thirteen and one-half feet, at Fink's basin, two miles east of Little Falls, in tow-path; has been repaired.

No. 16. Is located two and one-half chains west of lock 36; spillway, eleven and one-half feet, two valves, five and one-half by two and one-half feet.

Section No. 4.

No. 17. Waste-weir and spillway, about a quarter of a mile west of Little Falls, in the tow-path. This is an old structure of cut stone, arch, twelve feet chord, with sixty feet spillway. Masonry has been repaired.

No. 18. Waste-weir and spillway, just above lock No. 40, in tow-path; cut-stone arch, twelve feet chord; spillway, twelve feet, has been abandoned; should be repaired and put in working order.

No. 19. Spillway of seventy-five feet, located ten and one-half chains west of lock No. 41; has four valves two and one-half feet by two feet two inches; apron needs replanking.

No. 20. Is eighteen chains west of lock 42, filled up and not used.

ERIE CANAL — CULVERTS.

Section No. 1.

The masonry of all culverts on this section is in good repair. I would recommend that all diving culverts be pumped out and cleaned. The culvert numbers are as given in my report for the year ending September 30, 1884.

No. 12. Between locks 3 and 4, the south side of the lower wing is badly undermined by the slate rock being washed away, and needs a protection wall under and in front of it; also new planking through the arch, and the masonry should be pointed. In my report of last year this structure was called No. 10. The old number as shown on map was used.

Section No. 2.

No. 21. At Clute's dry dock, between locks 18 and 19. The berme end was injured by the break at this point last year; where damaged the trunk has been rebuilt of wood and the wings and parapets relaid. The tow-path end is in bad condition. I would renew my recommendation of last year, that the entire structure be rebuilt of stone.

No. 22. On level between locks 18 and 19. Small box culvert. Masonry, dressed stone. Parapet and wings on tow-path end are badly broken and displaced, and must be relaid soon. A ditch several hundred feet long is badly filled up, and should be cleared.

No. 28. Between locks 22 and 23. One-half mile west of Schenectady; dressed stone arch. The masonry is falling to pieces at the towpath end of structure, and must be relaid soon. Also the ditch should be cleaned.

No. 37. Is located 270 chains west of lock 25. Wooden box through the tow-path is in very bad condition and should be removed and replaced by bank. There is no necessity for a structure in this place.

Section No. 3.

No. 40. Between locks 27 and 28. Masonry has been pointed, new coping needed, and culvert is filled up to within three feet of the arch. Creek channel should be deepened.

No. 41. On the same level, dressed stone arch seven feet chord. Masonry needs pointing, also a new course of plank over the foundation timbers in the arch, and the channel should be excavated.

No. 45. Situated on same level, about one-fourth of a mile west of Port Jackson. Dressed stone masonry. Arch four foot rise, twenty-two foot chord. A large amount of excavating will have to be done to clear the channel.

Not numbered. There are two box culverts for draining the prism through the towing-path at Yankee Hill, both of which are old and need repairs.

No. 56. Seven hundred and seven chains and forty links west of lock 30. This structure is virtually abandoned. The West Shore and Buffalo Railway widened the canal at this point and filled up the berme end, so that the outside water flows into the canal instead of passing through the culvert.

No. 69. Located on level between locks 33 and 34. Is an old wooden trunk through the tow-path, and considered unsafe; a new one is needed.

Section No. 4.

No. 70. Between locks 34 and 35. Two hundred and ten chains west of lock 34. The tow-path end is entirely out of sight, and is covered with water and earth. The channel should be cleared.

Many culverts under bridge approaches need more or less repairs. Rocky Rift feeder culvert, under Castle creek, consists of six openings, each six feet by three feet. The paving protection over the covering stone has been entirely washed away, and some of the covering has been displaced, causing more or less leakage from the creek into the feeder, besides endangering the safety of the structure; the covering should be relaid, new paving laid, secured by anchor timbers and plank, also portions of the wing walls above and below the structure relaid.

The balance of the culverts between lock 27 and the west end of this division have been repaired and the masonry pointed during the year.

The channels and ditches above and below many of them, need more or less cleaning.

ERIE CANAL — BRIDGES.

The number and locations are as given in my report for the year, ending September 30, 1884, pages 36 to 48.

The following wooden bridges have been rebuilt by the Superintendent of Public Works during the year.

Section No. 2.

No. 39. Between locks 18 and 19. Station 340+21. Farm bridge.

No. 52. Between locks 19 and 20. Station 69+55. Road Bridge, Vischer's Ferry.

No. 61. Between locks 22 and 23. Station 230+12. Road bridge.

No. 81. Between locks 25 and 26. Station 40+25. Farm bridge, Turnbull's.

Section No. 3.

No. 90. Between locks 30 and 31. Station 219+72. Farm bridge, Coon's or Wemple's.

No. 109. Between locks 30 and 31. Station 538+90. Farm bridge, Starin's.

No. 112. Between locks 30 and 31. Station 813+50. Farm bridge, Downing's.

No. 120. Between locks 31 and 32. Station 82+64. Farm bridge, Kelly's.

No. 135. Between locks 33 and 34. Station 65+90. St. Johnsville, road bridge.

Section No. 4.

No. 149. Between locks 35 and 36. Station 216+45. Farm bridge, Connor's.

No. 180. Between locks 45 and 46. Station 186+92. Farm bridge, Van Buren.

No. 185. Between locks 45 and 46. Station 386+94. Farm bridge, Four-mile grocery.

No. 186. Between locks 45 and 46. Station 441+88. Road bridge, Austin's.

No. 188. Between locks 45 and 46. Station 495+55. Farm bridge, Ferguson, West.

The following bridges should be rebuilt:

Section No. 1.

No. 32. Between locks 17 and 18. Four chains south of lock 18, Lansing's Farm. This is a wooden whipple truss with iron lower chords, built in 1873. The lower truss is badly warped, wood-work should be rebuilt, using the old iron work.

Section No. 2.

No. 44. Between locks 18 and 19. Station 542+93. Wooden farm bridge.

No. 71. Between locks 22 and 23. Station 365+78. Rotterdam street bridge.

No. 75. Between locks 24 and 25. Station 99+18. Road bridge, Van Slyke's,

No. 84. Between locks 25 and 26. Station 185+78. Hoffman's Ferry, road bridge, Patterson.

Section No. 3.

No. 123. Between locks 31 and 32. Station 241+76. Farm bridge, Bullock's.

No. 126. between locks 31 and 32. Station 370+34. Farm bridge, Wagner's.

No. 131. Between locks 32 and 33. Station 89+88. Farm bridge, Lipe's.

Section No. 4.

No. 145. Between locks 34 and 35. Station 217+40. Farm bridge, Shall's.

No. 146. Between locks 34 and 35. Station 241+40. Farm bridge, Green's.

No. 155. Between locks 39 and 40. Station 97+32. Farm bridge, R. N. Casler.

No. 156. between locks 39 and 40. Station 178+25. Farm bridge, Henry Casler.

No. 157. Between locks 40 and 41. Station 72+92. Farm bridge, Snell's.

No. 160. Between locks 41 and 42. Station 30. Farm bridge, Steel's.

No. 163. Between locks 41 and 42. Station 223+12. Farm bridge, five and one-half chains south of lock 42.

No. 164. Between locks 43 and 44. Station 31+8. Farm bridge, Myers'.

No. 172. Between locks 44 and 45. Station 45+60. Farm bridge, Palmer's.

No. 177. Between locks 45 and 46. Station 74+40. Road bridge, Ferguson's.

No. 183. Between locks 45 and 46. Station 327+95. Farm bridge, Wesley's.

During the year the D. & H. C. Co. constructed a fine wrought-iron swing-bridge in the place of the old road bridge at the intersection of Fonda and Nott streets, Schenectady, near the Ellis Locomotive Works. This bridge was constructed and the old approaches cut away, under a permit given some time ago, so that the berne approach could be crossed by the company's tracks.

It is a great improvement, the present grade of approaches being very light.

Permission was also granted the same company to erect a new iron railway bridge and abutments, above lock 2, on this canal, so that a siding might be run from their main track to Breaker island, where the new Troy iron and steele works are being constructed. Work has been commenced on the same; it will probably be completed by December 1.

Between locks 22 and 23 at Rexford Flats, there is a bridge over the feeder thirty-seven feet clear span, which is in a dangerous condition, and should not be used.

This bridge is connected with the toll-bridge over the Mohawk, and we have been unable, after diligent inquiry, to discover who is responsible for the maintenance of the same; the general opinion is that it should be maintained by the Rexford Flats Bridge Company.

New needle-beams and planking have been put in the following bridges during the year.

Section No. 1.

No. 18. Ferry street, West Troy.

Section No. 2.

No. 67. Union street, Schenectady.

No. 65. Green street, Schenectady.

New needle-beams are needed in the following bridges:

No. 63. Front street, Schenectady.

No. 77. Road bridge.

No. 82. Farm bridge.

No. 59. Farm bridge.

Sidewalks should be placed on bridge at Frankfort street, Ilion, No. 173. Both berme and tow-path abutments are long enough for this improvement.

ERIE CANAL — BRIDGE ABUTMENTS.

Several bridge abutments on the berme side of the canal are considered in a dangerous condition, and many other are gradually becoming unsafe in consequence of having settled and being crowded over the embankment.

Some are now leaning into the canal, with the masonry overhanging from three to fifteen inches.

These abutments may be brought nearly into their original position, especially where the masonry is not broken or displaced, by removing the embankment back of them and excavating under the rear of the foundation, allowing that portion to settle, thus bringing them into place.

Some of the abutments have portions of masonry and coping displaced and need repairs. All of the old abutments being too low

to give twelve feet clearance from the water surface to the lowest points of the bridges, have been blocked up with wood, and should be lengthened and raised with stone.

This can be done by making the slope of the slips, for three or four courses from the top, one to one.

The following bridge abutments have been rebuilt during the year.

Section No. 3.

No. 101. Between locks 30 and 31. Station 280+50. Montgomery poor-house bridge. The berme abutment was taken down and rebuilt in a substantial manner, shortening the span.

No. 135. Between locks 33 and 34. Station 65+90. Coxe's road bridge, at St. Johnsville. Both abutments have been raised and lengthened and approaches improved to accommodate the new bridge constructed. The work was done under a special appropriation of the Legislature.

The following bridge abutments should be rebuilt or repaired:

Section No. 2.

No. 44. Between locks 18 and 19. Station 542+93. Farm bridge. The berme abutment leans toward the canal and is badly cracked.

No. 46. Between locks 18 and 19. Station 598+42. Road. Berme abutment, same condition as No. 44.

No. 62. Between locks 22 and 23. Station 264+88. Road. Berme wings should be repaired.

No. 83. Between locks 25 and 26. Station 117+40. Road. The berme abutment leans toward the canal and is badly cracked.

No. 86. Between locks 25 and 26. Station 398+53. French's farm. Berme abutment leans toward canal.

Section No. 3.

No. 92. Between locks 28 and 29. Station 138. Voorhees' farm. Same condition as No. 86.

No. 118. Between locks 31 and 32. Station 7+46. Ferry street road. Same as No. 92.

No. 119. Between locks 31 and 32. Station 49. Van Every's farm. Same as No. 118.

No. 123. Between locks 31 and 32. Station 241+76. Bullock's farm. Same as No. 119.

No. 127. Between locks 31 and 32. Station 475+40. Nellis' farm. Same as No. 123.

No. 133. Between locks 32 and 33. Station 337+16. Smith's farm. The wings of the berme abutment should be repaired.

Section No. 4.

No. 141. Between locks 34 and 35. Station 71+56. Snell's farm. Berme abutment leans toward canal.

145. Between locks 34 and 35. Station 217+40. Shull's farm. Same condition as No. 141.

No. 146. Between locks 35 and 36. Station 241+40. Green's farm. Same condition as No. 145.

No. 146. Between locks 35 and 36. Station 34+85. Fox's farm. Berme abutment leans toward canal, about fifteen inches out of plumb, and wings are badly cracked.

No. 158. Between locks 40 and 41. Station 160+40. Steel's farm. The berme abutment wings should be relaid.

No. 174. Between locks 44 and 45. Station 91+36. Litchfield street. Berme abutment settled badly and leaning toward canal.

No. 182. Between locks 45 and 46. Station 296+60. Robinson's farm. The west wing of the berme abutment should be relaid. West of lock 27, all bridge abutments except some of the above, which were not considered worth it, have been repointed.

No. 54. Between locks 20 and 21. Station 250+32. This bridge has been abandoned, and at present has no plank on it; the trusses are decayed and unfit for use. I would recommend that the old abutment stone be used for other purposes.

ERIE CANAL — EXTRAORDINARY REPAIRS.

By act chapter 472, Laws of 1884, the sum of \$1,200 was appropriated by the Legislature for the widening of the superstructure, and improving the approaches of a highway bridge opposite the highway bridge across the Mohawk river at St. Johnsville. The carrying out of the intention of this act necessitated the lengthening of both berme and tow-path abutments, and the building of a new superstructure.

This work has been done by the Superintendent of Public Works. By act chapter 279, Laws of 1885, the sum of \$2,000 was appropriated by the Legislature to construct an iron bridge over the Erie canal on the highway running from the village of Herkimer to Fort Herkimer, in the county of Herkimer. This bridge is to take the place of a wooden bridge now at that point. Plans have been prepared and a contract for this work has been awarded to O. F. Hill, and the bridge will shortly be placed in position.

In order to obtain the required "head-room" for the new bridge across the canal, it has been found necessary to raise the bridge across the Mohawk river at this point about two feet. Permission to do this has been obtained from the proper town officers, and the raising of the river bridge, the erection of canal bridge and the necessary grading have all been included in the contract, let to O. F. Hilt, and the whole work will be done within the amount of the appropriation.

By act chapter 246, Laws of 1885, the sum of \$600 was appropriated by the Legislature "to rebuild and place in safe and sound condition the suspension foot-bridge, over the Erie canal, at the

lumber district in the city of Albany." Plans have been prepared for a new wooden superstructure supported by iron towers, in the place of the present wooden trestles, and a contract for this work will be shortly let.

By act chapter 511, Laws of 1885, the sum of \$600 was appropriated by the Legislature for the construction of a foot bridge over the Erie canal, in the village of West Troy, at a point where Middle street crosses the canal.

Plans have been prepared for an iron superstructure resting on iron towers, and a contract for this work will shortly be let.

ERIE CANALS — PRISM AND BANKS.

The prism and banks are in fair condition. Repairs are needed to much of the slope and vertical walls, also docking which in many places is badly decayed, and should be renewed or replaced by vertical wall. The tow-path has been much improved in the last year, by means of graveling and the constant use of road-scrappers, the use of which should be continued, and enough more should be purchased by the State to be used on all sections of this division.

The use of these scrapers has been found to be effective and economical, less labor and material being needed to keep the banks in good repair.

The following repairs and improvements have been made to the prism, banks, walls and docking.

Section No. 1.

The prism on this section is in good condition; the usual cleaning out has been done.

The walls have been repaired and the docking is being constantly replaced.

Section No. 2.

The ridge left in the prism, between locks 20 and 21, by the dredge last summer has been removed.

The slope wall between locks 20 and the first waste-wier west of it is in very bad condition and should be rebuilt.

The walls on both sides, through the city of Schenectady, have been protected by new docking.

Between locks 25 and 26, the tow-path bank was much damaged by ice from the river; it has been repaired this year.

This section is in good condition, especially the tow-path bank, which has been greatly improved during the year.

Section No. 3.

About 220 feet of vertical wall in cement has been built on the berme side, from lock No. 20 west; the prism was widened, allowing much more room for boats to enter the locks. This has been a very beneficial improvement.

Section No. 4.

General repairs have been made on this section. Prism has been bottomed out, old walls and docking repaired and tow-path very much improved.

The following repairs and improvements should be made to the prism, banks, walls and docking.

Section No. 1.

The prism on this section is in good condition.

The banks are in good condition with the exception of the tow-path from lock 18 to the aqueduct; this portion is in much need of graveling. The walls need slight repairs.

The docking needs constant attention and is being renewed at all times.

Section No. 2.

At Vischer's Ferry there are two dry docks on the berme side which have been abandoned; the gates are decayed and unsafe. I would recommend that they be closed by vertical walls.

At the gravel bed on the berme side, between locks 18 and 19, about 100 feet of vertical wall should be built on the berme side, so that boats could be loaded.

That portion of the Schenectady level from the city west, nearly two miles, was originally constructed with timber and plank docking on both sides of the canal, which has now become old and unsafe, and requires constant attention.

I would respectfully renew my recommendations of last year, that a vertical wall in cement, placed on a broad timber foundation, be constructed in place of this docking.

Between locks 24 and 25, the slope wall on the berme side between bridges Nos. 76 and 77 should be rebuilt.

Between locks 24 and 25, on the tow-path side, beginning at the lock and running east about one-quarter of a mile, the slope wall should be rebuilt.

Section No. 3.

A piece of docking, similar to that on the Schenectady level from the city west, has been in use for some time on the inside of the tow-path at Big Nose.

This is more dilapidated than that at Schenectady, and has portions leaning into the canal, which may fall in if not soon attended to. I would recommend a similar vertical wall to be constructed at this point, also that the leaky places in the bottom of the canal at this point be covered with concrete.

Tow-path graveling is necessary at the following points:

From a point one mile east of Fultonville to Fultonville.

From Yatesville to lock 31.

The vertical wall on the berme, beginning at Fultonville and running about two miles east, is in bad condition, much of it having fallen into the canal and should be rebuilt.

A piece of wall on the tow-path near the first bridge east of lock 32 should be rebuilt.

About 200 feet of tow-path slope wall, just above Diefendorf Hill, should be relaid.

A piece of tow-path slope wall just above lock 33 should be relaid.

Section No. 4.

There is a weak spot on the river side of the Rocky Rift feeder, near bridge No. 131, station 89+88, which should be strengthened.

Just west of lock 34, on the tow-path side, there is about 500 feet of docking, which extends to canal bottom; it is badly decayed and should be replaced by vertical wall.

About three-quarters of a mile east of lock 36 there is a bad leak on the tow-path; the surface of the water in the river is below canal bottom and about thirty feet distant from the inner angle. I would recommend that a puddle wall be put in the tow-path at this point.

The tow-path retaining wall opposite lock 30 should be rebuilt.

There is docking extending to canal bottom from the head of lock 38 to the side cut of the old canal, about 100 feet; it is badly decayed and should be relaid by vertical wall in cement, with a new spillway at the side-cut.

The retaining wall on the tow-path side at the south of lock 39, between the two arches of the feeder, around the lock, is in a dangerous condition and should be rebuilt at once; the old wall was too light and is probably about four feet thick on bottom, being nearly twenty-two feet high; it should have had a base of about eight feet; it is built on rock bottom.

Just above Little Falls, for a distance of one and one-half miles, there is much leakage through the tow-path bank. I think this leakage is due to fissures in the rock bottom; although not dangerous it of course draws on the water supply.

About 300 feet of vertical wall should be rebuilt east of the street railroad bridge in the village of Mohawk.

Two hundred feet of vertical wall on the berme side of the Ilion aqueduct, and about 1,400 feet of vertical wall on the berme side through the village of Ilion, should be rebuilt.

The walls above lock 45 are in bad condition and will need many repairs.

The docking near lock 45, next to the creek, is breaking away and should be replaced by vertical wall.

NEW YORK, WEST SHORE AND BUFFALO RAILWAY.

The report of one of my predecessors in office for the year ending September 30, 1882, contains the following:

"I wish to call especial attention to the importance of the work being done by the New York, West Shore and Buffalo Railroad Company, in connection with the canal. * * *

[Assembly, No. 44.]

"Permission has been granted the company by the Superintendent of Public Works to occupy and construct their road partly on canal lands." * * * "While permits have been granted the company to construct their road in such proximity to the canal, it is to be done upon such conditions and requirements as the Superintendent of Public Works has imposed, and which it is believed will be of great advantage to the canal."

Since the above report was made, this railway has been built and is now in operation.

A large number of these "conditions and requirements" have been faithfully executed, and the result has been to so greatly improve the Erie canal, as to fully demonstrate the wisdom of the concessions made to the railway company.

But while this is true, it is also a fact that a great many of the "conditions and requirements" imposed on said railway company have been either imperfectly performed or not performed at all. In February, 1884, after a joint inspection of the work by the proper officials of the State and of the railway company, it was found that there remained to be done by the railway company, in order to comply with the terms of the permits granted them, at least thirty-two different pieces of work, and estimates of the cost thereof were made by the joint action of an engineer on behalf of the Superintendent of Public Works and one on behalf of the railway company. By these estimates it appears there was then remaining to be done at least \$140,000 worth of work. Since these estimates were prepared some of the work covered by them has been done but there remains a large portion of it yet to be done, the cost of which will exceed \$100,000.

The work done by the railway company during the past two years is as follows:

1st. The building of 550 lineal feet of retaining wall on berme side about one and one-fourth miles east of Fultonville; at this point the railroad embankment is about twenty-five feet above canal bottom and the material is yellow clay overlying a stratum of hard material about twelve feet below the canal bottom.

It was at first supposed that no protection would be needed here, but the weight of the railroad embankment caused the berme bank of the canal to slide and the centre of prism to bulge up. Piles were then driven to hold the bank, but these failed to answer the purpose, and recourse was had to a vertical wall in cement.

A substantial wall three feet wide on top, thirteen feet high with a batter of four inches to one foot placed on a foundation of ten inch by twelve inch timbers ten feet long, laid close together and planked, has been built here, and the base of foundation protected from sliding by piles driven in front thereof, twelve feet long, one foot apart.

2d. Widening of about 230 lineal feet of canal at eastern end of Flint Hill, so as to obtain a width of seventy-two feet on water surface. This width was obtained by rock cutting on berme side.

3d. Cutting off a rock point on berme side about one-half mile west of Fultonville, so as to obtain the required width of canal.

4th. Rebuilding of about 130 feet of vertical wall in cement at Diefendorf Hill. This is a piece of wall built during the construction of the railway, but which failed by being crowded out by the embankment which was not deposited behind it with sufficient care; it is three feet wide on top, three inches to one foot batter and twenty-four and one-half feet high.

5th. Excavation on berme side, east of Castle creek aqueduct; in order to restore about one acre of wide water destroyed by railroad embankment.

6th. Building of one new berme abutment for Montgomery county poor house bridge, about one and one-half miles east of Fultonville.

7th. Coping of vertical wall at Yankee Hill.

8th. Repairing State lock-house at Little Falls.

9th. Restoring of about four acres of wide water just west of Van Wie's aqueduct.

The principal pieces of work yet remaining to be done by the railway company are:

No. 1. Restoring about two acres of wide water on the different levels in place of that destroyed by the railway embankments.

No. 2. The building of vertical walls in cement on tow-path at Flint Hill, in order to obtain the necessary width of canal at this point.

No. 3. Building of about 300 lineal feet of vertical wall in cement at base of retaining wall; built by railway company at west end of Flint Hill to secure the same.

No. 4. Clearing out a double arch culvert, and building wing walls of bridge abutments above culvert at Phillips lock.

No. 5. Repairing culvert two miles east of Port Jackson.

No. 6. Rebuilding 600 lineal feet of vertical wall in cement at Yankee Hill, where wall built by railway company has failed.

No. 7. Building of fifty lineal feet of vertical wall in cement at east end of Big Nose.

No. 8. Removing and rebuilding a piece of vertical wall in cement on berme side about one-half mile east of Fort Plain. This wall was built by railway company but was improperly located, making prism of canal too narrow.

No. 9. Completion, according to the terms of the permits, of highway on tow-path side at Big Nose, and building of a fence at that point.

No. 10. Paving of about two miles of side of railroad embankment above vertical wall built by railway company at Yankee Hill.

When the above-mentioned permits were granted, the railway

company made a cash deposit of \$40,000 to the credit of the Superintendent of Public Works as an indemnity to secure the faithful performance of its obligations. A portion of this fund has already been expended, and I am informed that the Superintendent of Public Works proposes to expend the remainder in making the improvements thus guaranteed.

ERIE CANAL — DELAYS TO NAVIGATION.

I am able to report that there has been no delay in the navigation of the Eastern Division of the Erie canal during the year. This is a rare occurrence in the history of the canal, and is largely due to the constant and efficient watchfulness and care of the Superintendent of Public Works and his subordinates in charge of this division.

CHAMPLAIN CANAL.

The condition of this canal has been greatly improved during the past two years. Much work still remains to be done, and extra appropriations for extraordinary repairs will be necessary to accomplish the same, as the ordinary repair fund is barely sufficient to keep the canal in navigable condition.

The berme banks in most cases are without timber or stone protection and the slope walls on the tow-path are in most cases in such a condition that repairs are impossible and the only available remedy is to rebuild them from canal bottom to the angle. On many of the levels there is no protection on the tow-path from the angle to a point about two feet below water surface. The water is constantly encroaching on the banks, narrowing the tow-path and rendering the embankments unsafe, teams being unable to pass in many places. The tow-path banks are low, frequently but a few inches above water surface, and frequent overflows occur.

The prism on some of the levels is so filled up by material washed in from high berme banks, that boats are unable to pass; during the year this defect has been removed in many places on sections 2 and 3 by dredging.

There is but little gravel on the tow-path bank except on section 3. The scarcity of gravel pits on this canal and the distance necessary to haul the same makes graveling very expensive. Many of the State gravel pits have been exhausted.

The docking is in very bad repair and requires constant attention. The bank at the angle being washed away, leaving no foundation for the same, the only means for holding it in place is by the supporting power of the ties spiked on the lower side. The masonry on this canal is in fair condition. Many structures have been renewed and many more should be.

A list and description of work done on extraordinary repairs during the past two years by contract, and the Superintendent of Public Works, is given in this report.

CHAMPLAIN CANAL — LOCKS.

There are eighteen lift and five guard-locks on the Champlain canal; two of the guard-locks are at the Mohawk river at Cohoes; two at the Hudson river at Northumberland, and one about half way between Fort Ann and Whitehall near the Wood creek feeder dam.

There are also three lift-locks combined on the Waterford side-cut and one weigh lock at Waterford. All of the above-mentioned locks are 110 feet by 18 feet each in the chamber with various lifts as shown by the accompanying table. All the locks are on the enlarged plan and of the same size as those on the Erie canal.

There is also one river-lock at the head of the navigation on the Hudson connecting with the pond above the Troy dam, which is 115 feet by 30 feet in the chamber.

No.	NAMES.	Feet, lift.
1.	Cohoes lock.....	+11.5
2.	Cohoes lock.....	+11.5
3.	Guard-lock, south side Mohawk river.....	0.0
4.	Guard-lock, north side Mohawk river.....	—0.28
5.	Lock above Waterford.....	+13.27
6.	Lock above Waterford.....	+11.348
7.	Flynn's lock.....	+9.288
8.	Hewett's lock.....	+11.095
9.	Becker's lock.....	+8.297
10.	South guard-lock, Northumberland.....	+0.0
11.	Saratoga guard-lock, Northumberland.....	+9.92
12.	Bassett's lock.....	+9.295
13.	Fort Miller lock.....	+9.789
14.	Moses Kill lock.....	+9.098
15.	Fort Edward summit level.....	—8.00
16.	Upper combined, Fort Ann.....	—8.24
17.	Middle combined, Fort Ann.....	—8.137
18.	Lower combined, Fort Ann.....	—7.109
19.	Parish lock, Wood creek.....	—2.045
20.	Guard-lock, Wood creek.....	—0.138
21.	First combined, Whitehall.....	—9.00
22.	Second combined, Whitehall.....	—9.00
23.	Third combined, Whitehall.....	—10.00

Section No. 1.

Lock No. 1. One upper and two lower gates of this lock should be renewed. The masonry is in fair condition.

Lock No. 2. One upper and the two lower gates should be renewed. Masonry is in fair condition.

Sloop-lock at Troy dam. The masonry of this lock is in bad condition. The walls are bulged in and considerable pointing

should be done. The upper gates are in a dangerous condition and should be renewed at once.

Lock No. 3. New upper gates are needed. I would recommend that the lower half of the walls of this lock be raised to the same elevation as the upper, which is about three feet higher. Navigation has been interrupted during high water in the river, when the water in the same has been higher than the lower end of the lock. The elevation of the dam is about six feet lower than the head and three feet lower than the foot of the lock.

Lock No. 4. This lock is in good condition.

Waterford side-cut locks. One pair of upper gates are needed at these locks; the masonry is in good condition, except the breast walls, which need repointing and grouting.

Waterford weigh-lock. The upper gates have been renewed and about 125 feet of the north wall of the culvert discharge on the tow-path side has been rebuilt to a greater elevation than the old, and coped with timber. The lock and discharge have been cleaned out.

Lock No. 5. The upper gate has been renewed. Masonry is in fair condition.

Lock No. 6. The upper gate has been renewed, and the lower gates need slight repairs. There must be some defect in the walls of this lock, as it is necessary each year at the close of navigation to brace the walls so that the frost may not force them in.

Lock No. 7. The masonry of this lock is in fair condition. I would recommend that the chamber walls be raised one foot, as the coping is but three inches above the ordinary elevation of water in the upper level. This improvement could be made by relaying the coping on a new twelve-inch course of stone.

Lock No. 8. This lock is in good condition.

Lock No. 9. The leakage through the east wall of this lock has been fully checked; the chamber was pumped out and a thorough examination of the bottom revealed the fact that the lower joints were open and the walls hollow. The joints were raked out, the horizontal ones pointed and many barrels of grout run in through the verticals. This shut off all leakage through the lock walls on the tow-path side. A cut-off wall of clay was put at the head of the lock, extending to a point above the wing wall, thereby cutting off most of the leakage at the head of the lock. There is still a small amount which can be effectually stopped by extending the puddle wall to the north. In excavating at the head of the lock two large water-courses were discovered and cut off. The time for opening the canal being near at hand, when the above repairs were made, the leakage through the berme wall could not be cut off. I would recommend that this be done at the close of navigation, in the same manner as on the tow-path.

Lock No. 10. Is in good condition. A new foot bridge has been constructed over it. The mitre-sills are about three feet

below the bed rock of the river. The tow-path feeder has been re-covered with oak timbers, and new valves have been put in the berme feeder.

Lock No. 11. This lock is in good condition.

Section No. 2.

Lock No. 12. Is in fair condition; there is some leakage through the lower end of the berme wall. Lower gates have been renewed.

Lock No. 13. Is in good condition. The upper gate has been renewed.

Lock No. 14. Is in good condition. The lower gates have been renewed.

Lock No. 15. Is in good condition. The upper gates have been renewed. The lower gates are in bad condition and should be renewed. The stop-gate on the west side of this lock has been repaired and is now in fair condition.

Section No. 3.

Lock No. 16. The lower end of the west wall has settled and needs repairs. There is considerable leakage through the chamber walls. The lower gates have been renewed.

Lock No. 17. Is in good condition.

Lock No. 18. Is in good condition.

Lock No. 19. Is in good condition.

Lock No. 20. Is in good condition.

Lock No. 21. This lock is in fair condition, except slight leakage through the berme wall; this wall should be stripped and puddled to prevent the water from following back and running into lock 22.

Lock No. 22. This lock is in fair condition. The upper gates have been renewed.

Lock No. 23. This lock is in good condition. The lower gates have been repaired.

There is more or less pointing to be done on all of the Champlain canal locks. I would recommend that all joints be thoroughly cleaned before filling, to insure adhesion of the mortar to the stone, also that Portland cement be used, and where there is an opportunity to do so, that grouting be tried, which would fill any hollow place back of the face stone.

CHAMPLAIN CANAL AND GLENS FALLS FEEDER—DAMS.

Section No. 1.

There are eight dams on and connected with this canal; for a description reference is made to my report for the year ending September 30, 1884.

No. 1. Located at Troy across the Hudson river, needs repairs and should have prompt attention. I would renew the recommen-

dation made in my report of last year. Part of the apron at the fishway, where former repairs have been made, has been badly damaged, the new flooring placed there, not being securely fastened, has been displaced.

No. 2. Located at Cohoes across the Mohawk river. About 300 feet of the face of this structure was found to be so badly bulged as to render it necessary to construct buttresses to support the same. One large and three smaller buttresses were designed to strengthen the damaged portion, but owing to the unusual high water during the prosecution of the work, but three were constructed; the fourth, situated on the south end of the bridge, was omitted, as it was not considered safe to open any more of the old apron. Constant repairs are needed on the apron to this dam. I would recommend that the base of the apron be extended about eight feet, making the total width on bottom about twenty feet. The present width, about eleven feet, is not sufficient to resist the thrust of the ice and water passing over it in times of high water. The coping, which is raised from its bed, at the damaged portion of the dam, should be relaid, clamped and securely bolted to the masonry.

Section No. 2.

No. 3. Saratoga dam, located at Northumberland across the Hudson river, is in good condition. I would recommend that cribs of timber and stone be sunk in the pond in line with the east side of the lock and extending as far north as the angle in the dam. These cribs should be about forty feet in the clear, and a heavy floating boom attached, which would, in times of high water, render navigation across the pond safe, and prevent boats being carried on or over the dam. The distance from the shore to the dam at this point is short, and the currents produced by the curves in the shore and the discharge over this end of the dam render it almost impossible for boatmen to make fast their boats when tow-lines break. These cribs should be built on a batter from the bottom to a point two feet below low-water mark, and from that point plumb to a height of six feet above the ordinary level of the water, so that boom-guides or frames could work up and down with the different stages of water.

Section No. 3.

No. 4. Located near Fort Ann across Wood creek on the berme side just south of lock 19. The masonry needs slight repairs and pointing. I would recommend that the old-fashioned gates in this dam be replaced by the improved wrought-iron gates and gearing. Much difficulty is experienced in operating the present gates.

Nos. 5, 6 and 7 are on Wood creek, between locks 19 and 20. The gates in No. 7 on the berme side, just south of lock 20, should be replaced by the improved wrought-iron gates. Some of the old gates will not work, and are closed by planking.

No. 8. Is located at the head of the Glens Falls feeder, two miles west of Glens Falls, across the Hudson river. The masonry on the berme side connected with the dam at the foot of the lock needs slight repairs.

CHAMPLAIN CANAL — AQUEDUCTS.

There are four aqueducts on this canal.

Section No. 2.

No. 1. Located at Schuylerville. The berme wing walls are being crowded into the creek, should be relaid, raised and lengthened, the outside slope of the banks on this side are too steep and cannot be properly enlarged until the masonry is built to conform to the proper slope. I would recommend that the wings be raised with masonry, and lengthened by cribs of timber and stone, and the banks widened. The masonry needs pointing.

No. 2. Between locks 12 and 13. Known as the Fort Miller aqueduct. The south wing on the tow-path side, twenty-seven feet long, is settling and bulging out, and a portion of the parapet wall and arch is breaking up, and will need relaying to put the structure in complete repair. The berme side masonry is in good order.

No. 3. Located just above lock 14, and known as the Moseskill aqueduct. The masonry joints are filled with vegetable growth and should be thoroughly cleaned and pointed. The tow-path bridge has been rebuilt, new trunk braces put in, and the masonry of the berme abutment repaired.

No. 4. Located at Fort Edward. The sides of the trunk should be removed and the masonry pointed. The tow-path wing walls should be relaid.

CHAMPLAIN CANAL — WASTE-WEIRS AND SPILLWAYS.

There are twenty-eight waste-weirs and spillways on the Champlain canal. One new one on the level between locks 5 and 6. Berme side has been constructed during the year. The following have been rebuilt during the past two years.

Section No. 1.

Burton's waste-weir and spillway on the tow-path side at Waterford.

Section No. 2.

Waste-weir on the tow-path side between locks 11 and 12.

Section No. 3.

Waste-weir and spillway in Wood creek just south of lock 20. Empie's waste-weir and spillway on the tow-path side between locks 15 and 16. Twelve-mile level and Eastman's waste-weir and spillway on the tow-path side south of Whitehall.

On section 2, a new spillway has been constructed on the berme side. This structure was much needed. The level is short and it was difficult to control the water. The following needs repairs:

Section No. 2.

The first below lock 8 on the tow-path side needs a new apron. The bulk-head and wickets have been removed.

Between locks 8 and 9, just north of Mechanicville on the tow-path side, the masonry of this structure is in bad condition, the joints are open, and the spillway wall badly bulged; many stone in the piers are displaced; there is much leakage through the walls, and the bulk-head is in a dangerous condition. I would recommend that the structure be rebuilt on the improved plan, similar to Burton's and Eastman's, with improved gates. The structure cannot be repaired; the only remedy is to rebuild.

The Stillwater waste-weir is in the same condition as the one just mentioned at Mechanicville; I would offer the same recommendations.

At the first waste-weir below lock 10, the rock canal bottom between it and the lock is much higher than the sill of the waste-weir. I would recommend that a channel be cut in the rock between these two points, so that the upper end of the level and the lock chamber could be drained.

Section No. 3.

O'Brien's spillway, the first south of the Glens Falls feeder, between locks 15 and 16, needs a new tow-path bridge.

Dunham's basin waste-weir. The pier masonry on the canal side needs relaying, and fenders should be put on them to prevent injury from boats. The first waste-weir below Smith's basin is in bad condition—should be rebuilt on the improved plan. Smith's basin waste-weir should have new improved lift-gates.

The waste-weir at the head of lock 21, on the tow-path at Whitehall, is so near the lock that it cannot and has not been used. I would recommend that it be walled up and abandoned. The old waste-weirs on the canal should be pointed.

CHAMPLAIN CANAL — CULVERTS.

There are twenty-seven culverts on the Champlain canal (in my last report one was omitted, located about one mile south of Fort Ann), twenty under the canal, two through the tow-path in the river at Northumberland, two for highways, Third and Fourth streets in the village of Waterford, one for the feeder at lock No. 4, two for feeders at lock No. 10.

Section No. 1.

The following culverts have been rebuilt:

At Thorne's lane above lock 6, the old wooden box has been replaced by a cut-stone box diving culvert, opening three feet by

four feet. At Fort Miller, the old arched structure has been replaced by a cut-stone box diving culvert, opening three feet by three feet.

The following have been lengthened :

Section No. 2

Landers' culvert, between locks 14 and 15, has been lengthened about thirteen feet. The berme parapet of the iron pipe culvert, three-fourths of a mile north of Moseskill lock No. 14, has been raised and strengthened so that the bank could be widened and strengthened. Box culvert about one and one-quarter miles north of lock 8 on section 2 should be rebuilt; the opening is three feet by three, and is not large enough to carry the water in times of freshets.

The following need repairs :

Section No. 2.

Arch culvert at Saulsbury's on the berme side, the ring stone and parapet are crowded out, and the wing-walls need relaying. There is leakage from the canal through the arch at point near the vertical wall on the berme side.

Section No. 3.

Culvert about three-fourths mile south of Fort Ann.

This is an old structure; it is so much covered and filled with earth that an examination could not be made. In the rainy season a large amount of water collects on the berme side, forming a pond which saturates a weak bank composed of light porous material, rendering the same liable to break away. I would recommend that this structure be uncovered at the ends, cleaned out and thoroughly examined; my opinion is that the opening is too small.

There is a culvert about seventy-five feet north of lock 19, which was built to drain the adjoining farm lands; it runs diagonally under the tow-path and empties in the canal. In times of heavy rains it fails to carry off the water which accumulates, and the lands are flooded. I have made as thorough an examination as could be made without uncovering it, and am of the opinion that the side walls have bulged in, thereby reducing the water-way.

Walker's culvert at Whitehall has much leakage from the canal through the covering and under the foundation at the tow-path parapet wall.

The balance of the culverts on this canal are in fair condition; nearly all need considerable pointing. I would recommend that all diving culverts be examined, and when necessary cleaned out; many of them have not been cleaned out for years, and are partially filled with deposits which contract the openings to such an extent as to render them almost useless.

CHAMPLAIN CANAL — BRIDGES.

There are 154 bridges on the Champlain canal, including the bridge across the Mohawk river at Cohoes. Two new ones constructed and one abandoned during the year. In addition to the above numbered bridges there are nine railroad bridges. (See report for year ending September 30, 1884.

The following bridges, with their abutments and approaches, have been constructed during the year :

Section No. 1.

Iron road bridge at the continuation of Arch street, Green Island.

Section No. 3.

Road and change bridge about fifty feet north of lock 20.
The following bridges have been rebuilt during the year :

Section No. 2.

McDonald's farm bridge, first below lock 7; Best's road bridges, at Pulp mill, Mechanicville; Best's farm bridge, second south of lock 9, just above Mechanicville; farm bridge, third north of lock 9, south of Stillwater; Wetsell's farm bridge, Stillwater, between locks 9 and 10; first road bridge, south of Stillwater waste-weir, between locks 9 and 10; Wood's road bridge, north end of Stillwater waste-weir, between locks 9 and 10; Baldwin's farm bridge, south of Bemis Heights, between locks 9 and 10; Cramer's south farm bridge, between locks 9 and 10; Cramer's middle farm bridge, at Coveville Bend, between locks 9 and 10; Chuff's farm bridge removed, and Tompkin's bridge, which was abandoned, put in its place; Stoaver's farm bridge, Brisbin's road bridge, between locks 13 and 14; Moseskill road bridge, between locks 14 and 15; first farm bridge south of iron pipe culvert, between locks 14 and 15; Landers' road bridge, first above Landers' culvert; Farm bridge No. 96, first above waste-weir No. 13; road and change bridge, foot of Glens Falls feeder; new bridge, iron.

Section No. 3.

Road bridge, eleven chains north of lock 20; road bridge at first railroad bridge; north of lock 20; farm bridge one mile south of Whitehall; foot bridge south of lock 21, in Whitehall; new bridge is iron.

The following bridges should be rebuilt:

The tow-path and highway bridge at Cohoes across the Mohawk river I consider to be unsafe. The timber is very much decayed, and has been repaired from year to year; the different members are out of adjustment and the dimensions so changed by the many repairs made, that it seems to me to be advisable to recommend that

the old structure be removed and replaced by a substantial iron structure, having a wider roadway and suspended sidewalk; the piers are sufficiently large for this change. This bridge is on the only highway between Cohoes and Waterford; and is much used. There could be no better time on the score of economy for erecting an iron bridge here than the present. Road bridge above lock 6, at Thorne's lane. This is a wooden whipple truss with lower chords of iron; the woodwork is very much decayed, and in a dangerous condition; the old iron can be used again. First road and change bridge south of lock 10. This bridge is unsafe, and should receive prompt attention. Tow-path bridge over old canal below lock 10.

Section No. 2.

First road bridge above waste-wire No. 1, between locks 14 and 15; Howe's road bridge, third above Landers' culvert, between locks 14 and 15; farm bridge, fourth above Landers' culvert. The old bridge taken from above; Moseskill lock can be used here; road bridge, fifth above Landers' culvert.

Section No. 3.

Second farm bridge below lock 16, Fort Ann; tow-path bridge over Mud or Dead creek on Wood creek; Boardman street bridge, Whitehall, needs prompt attention; the Rennselaer and Saratoga railroad bridges at Waterford and Whitehall, reported as being low (see my report for 1884) have been raised. Also the Curtis farm bridge above Bemis Heights. The bridges on section 3 have been repainted with two coats of best white lead paint. I would recommend that the same be done with those on sections 1 and 2. Tompkins' farm bridge, first above Ensign's tile works, between locks 9 and 10, has been abandoned; the State purchased the right to the bridge from the property-owner. The superstructure has been put up in the place of the Chubb farm bridge, and the stone in the abutments used for general repairs. The wooden approaches to the Whitehall change bridge have been renewed this year.

CHAMPLAIN CANAL — BRIDGE ABUTMENTS.

The following abutments have been rebuilt during the past year:

Section No. 1.

Berne and tow-path abutments for the Division street bridge, Waterford; the approaches have been raised and lengthened; second bridge above lock 6, Weaver's new tow-path abutment; second bridge below lock 9, Best's new tow-path and berme abutment; third bridge above lock 9, south of Stillwater, new tow-path abutment; first bridge north of Stillwater, Stratton's new berme abutment; at Coveville Bend, Cramer's middle bridge new tow-path and berme abutment.

Section No. 2.

First bridge north of lock 14, new tow-path abutment; two new abutments for bridge over escape to waste-weir No. 12, bridge, ninety-six dollars; first above waste-weir No. 13, new berme abutment; foot of Glens Falls feeder, new berme abutment, and tow-path abutment raised and lengthened.

Section No. 3.

About fifty feet north of lock 20, new tow-path and berme abutment; eleven chains north of lock 20, new tow path and berme abutment; at first railroad bridge above lock 20, new tow-path abutment; one mile south of Whitehall, new berme abutment.

The following abutments need repairs:

Section No. 1.

Dean's farm bridge, near Coveville, between locks 9 and 10, the berme abutment wings should be relaid; many stone are out and some displaced. Slade's farm bridge. This bridge is on wooden bents, the one on the berme side is in bad condition and should be renewed; McDonald's farm bridge, first below lock 7, berme abutment should be rebuilt; Best's road bridge at the Pulp mill, Mechanicville, the tow-path abutment is badly cracked and the face stone separated from the backing, it will be necessary to rebuild the abutment; heavy loads are constantly passing over this bridge.

Hill's farm bridge, first above Bemis Heights upper road bridge, The berme abutment (reported last year as "Baldwin's" bridge abutment) has fallen into the canal and will need to be rebuilt. The old stone taken out are filled with seams and cannot be used in new work; part of them have been used for repairs to prism walls. The tow-path abutment is low and should be raised.

Smith's farm bridge, third above waste-weir No. 7, between locks 9 and 10, the berme abutment should be rebuilt.

Section No. 2.

First bridge south of lock 13, Moseskill lock. The approaches to this bridge have been in an unsafe condition, especially in the winter, being steep and narrow. The berme approach has been widened and lengthened. I would recommend that the same be done with the tow path approach.

Howe's road bridge, near waste-weir No. 13. Berme abutment in bad condition; should be rebuilt.

Coleman's farm bridge, first above change bridge at foot of feeder. Tow-path abutment is in very bad condition and should be rebuilt.

Section No. 3.

Tow-path on Wood creek over Mud or Dead creek. Abutments and center pier should be rebuilt.

Kibbie's farm bridge, second above first railroad bridge, north of lock 20. The berme abutment leans badly toward the canal and should be rebuilt.

Farm bridge, No. 42, old number. The berme abutment is sliding into the canal and should be rebuilt.

Taft's farm bridge, first above iron railroad bridge. Berme abutment sliding into canal; should be rebuilt. I would recommend that the following tow-path abutments be set back and new bridges built, so that the tow-path roadway may be widened to fourteen feet: First bridge south of Burton's waste-weir, on section 1. Fisher's bridge, below lock 7. There is about eight feet space between the inner angle and abutment at this bridge. Powers' bridge, first north of Fisher's. Same clearance as at Fisher's. I would also recommend that the old tow-path approach to the bridge opposite lock 22, in Whitehall, be removed and a timber approach constructed; also that it be placed nearer the creek. The old stone could be used for repair purposes. Many of the abutments on this canal need pointing, and a large number are low, the necessary heights being obtained by blocking up with timber.

CHAMPLAIN CANAL — VERTICAL AND SLOPE WALLS.

The walls on this canal, with the exception of those constructed during the past six years, are in bad condition.

Vertical Walls.

The vertical walls, in most cases, were constructed with a face averaging scarcely twelve inches in thickness, with a small amount of backing, poorly laid with no bond to the face. As an illustration take one of many.

The vertical wall on the tow-path side in the village of Whitehall, from station 2,600 to lock 21, built in 1873, from figures given in the final account book, is represented to have been about twenty-five feet in area. In making repairs to the same, where it had fallen into the canal, rebuilding per specifications, and using all stone originally in the wall, a section of about eight cubic feet in area was all that could be constructed. When such poorly-constructed walls need repairs it becomes necessary to start at the bottom and rebuild entire. General repairs have been made where most needed on the three sections. The following should be promptly attended to for the protection of the banks.

Section No. 1.

At lower end of lock No. 2 a large piece of wall has fallen down. On the berme side between locks 1 and 2 the wall is in a very bad condition.

Section No. 2.

The tow path and berme vertical walls between lock 10 and the new wall recently constructed is in a very bad condition. On the tow-path side, much of the wall has fallen into the canal, and the opening planked in order to give a passage-way for teams. In the winter of 1867 the canal, about one mile south of Fort Edward, was widened by cutting away the high tow-path bank, the rear slope of which extends to the river, and a vertical wall laid partly with and without cement was built, to protect the bank. In the spring, after the water was let in, about 800 feet of the bank slid into the river. There is a stratum of hard pan from six to ten feet below the surface of the ground, upon which the earth slid. At different periods from that time it has been necessary to weight the bank with cribs of timber and stone, which in many cases have been placed too near the rear angle of the bank, instead of at the foot, thereby increasing the tendency to slide. I would recommend that the old wall be replaced by a heavier one, laid in cement and thoroughly puddled at the toe, so that there may be no leakage under or through it.

Section No. 3.

The tow-path walls between station 2,600 and lock 21 at Whitehall, about nine chains, should be rebuilt entire. I would recommend that all docking at the heads of locks, connecting with the wings, be replaced by vertical walls in cement.

Slope-walls.

On many levels the prism has been excavated below the toe of the wall, the action of frost has displaced the same and caused the wall to settle and bulge. In making repairs it is necessary of rebuild from the foundation to the top.

Docking.

The docking on all three sections is for the most part badly decayed and needs constant attention; owing to the want of a suitable foundation the dock sticks are held up by the ties and quickly become displaced. On section 1 at the head of lock 3, between the lock and vertical wall on the tow-path side, the docking is in very bad condition; in many places has broken away, leaving dangerous holes. It has been recommended that instead of replacing it, cribs of timber and stone be sunk on the outside of the old docking to form a foundation for restoring the tow-path. The vertical wall just north of this docking was constructed on cribs, sunk in sections.

Prism and Banks.

The prism of this canal needs constant attention, especially on sections 1 and 2, owing to the material washed in by rains from

the high banks on the berme side, also to the deposits made by the many streams which flow into it. Extensive bars form each year from the latter cause. The materials washed in from the banks interferes with navigation, narrowing the channel to such an extent that boats are unable to pass at many points, and become wedged.

Many of these narrow places on sections 2 and 3 have been widened by dredging during navigation and the material deposited on the berme bank. Extensive improvements have been made to the canal under extraordinary repairs, bends have been cut off, leaks stopped and substantial prism walls constructed. I would recommend that the prism of the canal at the Coveville break of 1884, at Costello's grocery, be filled into canal bottom, thereby reducing the pressure on the bank, and an earth filling put in back of the new crib across the breach of that date.

The banks on this canal, with the exception of section 3, are too low and are frequently overflowed, in times of sudden rain storms, by streams which empty into the canal. The tow-path on sections 1 and 2 needs gravel. The tow-path inner angle on the greater part of the canal is unprotected by docking or wall, and in some cases the water has cut into the bank from five to eight feet, endangering its safety and rendering it difficult for teams to pass and impossible to raise the banks where low. The unprotected portion extends to about two feet below the water surface.

I would recommend that a vertical wall in cement of the following dimensions (coped with timber or a stone extending over the full thickness of the wall) be constructed, top thickness two feet and six inches, batter three inches to one foot, height three feet, this would call for 1,687 cubic yards per mile for the wall proper.

If coped with a twelve-inch stone, making the top of the wall two feet above water surface, 489 cubic yards of coping. If coped with timber, ten inches by twelve inches, secured by ties and binders, about 76,000 feet, board measure, of timber—23,000 feet, board measure, of ties, and 53,000 feet, board measure, of pine docking. The bank could then be restored and given a sufficient drop toward the rear angle to secure the proper drainage away from the prism. It has been recommended that, instead of wall, docking be used; I do not think this would be advisable, for the following reasons:

The cost of each would be nearly the same; if docking were used, it would take 253,000 feet, board measure, of pine docking, and 92,000 feet, board measure, of oak ties; it would be necessary to excavate nearly all of the bank to a point two feet below the water, and fully eight feet back of the angle, thereby destroying the stability of the bank and rendering it liable to leakage. The entire improvement would also be constructed of perishable

material which would last but a few years. I would recommend that ditches be cut at the rear of the tow-path banks, also that the banks be widened and strengthened at the following places :

Section No. 1.

Between locks 5 and 6, on the berme side, just north of the new spillway. On the berme side between locks 8 and 9, beginning at the first waste-weir above the lock and running north and from the first culvert south of Fort Ann northward, the berme bank. (See engineer's estimate in this report.)

CHAMPLAIN CANAL IMPROVEMENT.

Under act chapter 97, Laws of 1882, the sum of \$199,877.80, being the unexpended balance of the sum of \$500,000 appropriated by act chapter 399, Laws of 1874, for the improvement of the Champlain canal, was reappropriated to be expended under the direction of the Canal Board, for continuing the improvement of the Champlain canal and Glens Falls feeder.

This unexpended balance with interest up to July 1, 1883, amounted to \$201,283.66.

By act chapter 301, Laws of 1884, the unexpended balance of the above was reappropriated, to be expended under the direction and for the purpose above stated.

The present condition of this fund is as follows :

Dr.

To amount appropriated by act chapter 97, Laws 1882, with interest to July 1, 1883.....	\$201,283 66
Interest July 1, 1883, to July 1, 1884.....	5,712 61
Interest July 1, 1884, to July 1, 1885.....	3,346 34
Total.....	<u>\$210,342 61</u>

Cr.

By amounts appropriated by resolution of Canal Board (given in detail below).....	\$226,814 75
Less appropriations rescinded by Canal Board January 14, 1885 (given in detail below).....	11,921 98
	<u>\$214,892 77</u>
Less excess of appropriations over final accounts.....	18,044 02
	<u>\$196,848 75</u>
Amount available for further improvements...	<u>\$13,493 86</u>

To the above total of \$13,493.86 is to be added \$9,581.94, the balance left over from the pieces of work done by the superintendent of Public Works, and from it is to be deducted \$133.89, the amount expended by the Superintendent of Public Works for advertising, printing, etc.

The total amounts set aside from this fund by the Canal Board heretofore referred to are detailed as follows, necessary engineering expenses being included in each piece of work :

No.	DESCRIPTION.	Set aside by Canal Board.	Amounts.
1.	For widening and improving the Champlain canal, south lock No. 5.....	Dec. 28, 1882	\$1,536 98
2.	For widening and improving the Champlain canal in the village of Watertord, between Broad and Division streets.....	Dec. 28, 1882	8,676 75
3.	Rebuilding waste-weir at Burton's mill, Waterford.....	Jan. 15, 1884	4,976 00
4.	Building spillway between locks 5 and 6.....	Jan. 15, 1884	3,166 00
5.	Widening and deepening prism, also building one new tow-path bridge abutment, and one superstructure at Stillwater.....	Jan. 15, 1884	19,485 00
6.	Improving prism, including one bridge superstructure and its abutments at Coveville.....	Jan. 15, 1884	29,463 00
7.	Rebuilding waste-weir above lock 11.....	Jan. 15, 1884	2,249 00
8.	Strengthening berme bank and rebuilding culvert three-fourths mile south of Fort Miller lock.....	Jan. 15, 1884	3,770 00
9.	Improving prism and banks one-fourth mile south of Moseskill lock.....	Jan. 15, 1884	1,725 00
10.	Strengthening banks between Moseskill lock and Moseskill aqueduct.....	Jan. 15, 1884	650 00
11.	Strengthening berme bank three-fourths mile north of Moseskill lock.....	Jan. 15, 1884	1,344 00
12.	Improving prism and banks at Woodchuck point.....	Jan. 15, 1884	8,660 00
13.	Improving prism, including one bridge superstructure and one		

No	DESCRIPTION.	Set aside by Canal Board.	Amounts.
	bridge abutment at foot of Glens Falls feeder.....	Jan. 15, 1884	\$2,252 00
14.	Building new tow-path and change bridge at lock 20....	Jan. 15, 1884	5,912 00
15.	Rebuilding Eastman's waste-weir two and one-half miles south of Whitehall.....	Jan. 15, 1884	2,906 00
16.	Improving prism, one mile south of Whitehall, including one bridge superstructure and one berme bridge abutment.....	Jan. 15, 1884	11,900 00
17.	Improving prism between bridges 139 and 140 near Whitehall..	Jan. 15, 1884	2,906 00
18.	Building bridge and abutments over escape to waste-weir No. 12.....	Jan. 15, 1884	343 00
19.	Improving prism at railroad bridge north of lock 20.....	Jan. 15, 1884	7,365 00
20.	Improving prism and building docking at Smith's basin....	Jan. 15, 1884	930 00
21.	Building four tow-path and three berme bridge abutments....	Jan. 15, 1884	8,575 00
22.	Widening and improving the canal south of Fort Miller lock,	Jan. 22, 1884	1,545 00
23.	Widening and improving the canal at bridge No. 95 (stated as bridge 94 in Canal Board proceedings).....	Jan. 22, 1884	470 00
24, 25, 26.	Strengthening the leak- ing banks of the Glens Falls feeder, between Green's bridge and Finch & Pruyn's mill at Glens Falls; widening the up- per end of lock No. 10, Glens Falls feeder; widening and strengthening sluice at head of Fort Edward lock.....	Aug. 6, 1884	5,184 91
27.	Balance needed to finish the pro- posed improvement at Water- ford (No. 2 of this list).....	Aug. 6, 1884	906 74
28.	Balance needed to finish proposed improvement, rebuilding East- man's waste-weir (No. 15 of this list).....	Aug. 6, 1884	3,630 29
29.	Strengthening sloop lock at the Troy dam.....	Sept. 16, 1884	5,526 08

No.	DESCRIPTION.	Set aside by Canal Board.	Amounts.
30.	Raising two tow-path abutments and approaches; also for rebuilding one tow-path abutment and approach, and for building two wooden bridges,	Sept. 16, 1884	\$2,787 85
31.	Strengthening seven and one-third chains of berme bank at Mechanicville.....	Sept. 16, 1884	4,504 75
32.	Widening eleven chains of canal at Woodchuck Point.....	Sept. 16, 1884	2,597 95
33.	Improving eleven chains of canal between bridges 140 and 141, near Whitehall.....	Sept. 16, 1884	4,185 00
34.	Improving eighteen chains of canal near the railroad bridge at Whitehall.....	Sept. 16, 1884	12,192 00
35.	Rebuilding culvert and improving three chains of canal at Thorne's lane, above lock No. 6.....	Sept. 16, 1884	5,424 00
36.	Strengthening tow-path bank near Goveville.....	Sept. 16, 1884	6,689 20
37.	Improving eleven and one-half chains of Glens Falls feeder at Finch & Pruyn's Lime Kiln, Glens Falls.....	Sept. 16, 1884	6,019 50
38.	Rebuilding waste-weir near lock No. 20.....	Sept. 16, 1884	3,102 74
39.	Balance needed to complete proposed improvement of eighteen and one-half chains near Whitehall (No. 16 of this list),	Sept. 16, 1884	190 41
40.	Improving the berme bank between the north end of lock 8 and the waste-weir.....	Nov. 20, 1884	663 71
41.	For protecting with slope wall the berme bank of canal between Broad and Division streets, Waterford.....	Nov. 20, 1884	627 09
42.	Strengthening nine chains of tow-path, two and one-half chains north of Wilbur's basin waste-weir.....	Nov. 20, 1884	535 81
43.	Strengthening tow-path bank between bridges 79 and 80.....	Nov. 20, 1884	750 96
44.	Strengthening berme bank over culverts No. 14, between bridges 93 and 94.....	Nov. 20, 1884	282 35

No.	DESCRIPTION.	Set aside by Canal Board.	Amounts.
45.	Lengthening berme side of Landers' culvert (No. 15), and improving four and one-half chains of canal.....	Nov. 20, 1884	\$4,813 77
46.	Strengthening seven and a half chains of tow-path bank between bridges 102 and 103..	Nov. 20, 1884	601 33
47.	Rebuilding waste-weir No. 17 (Empie's), two and a half miles south of Fort Ann.....	Nov. 20, 1884	3,373 72
48.	Improving sixteen and a half chains of canal on berme-side, north of guard-lock, Waterford	Jan. 14, 1885	2,399 60
49.	Improving twenty-five and a half chains of the Glens Falls feeder, between guard-lock and first bridge thereof.....	Jan. 14, 1885	2,541 00
50.	Additional appropriation for Burton's waste-weir (No. 3 of this list).....	Jan. 14, 1885	2,564 40
51.	Additional appropriation for spillway between locks 5 and 6 (No. 4 of this list).....	Jan. 14, 1885	2,541 52
52.	Additional appropriation for sloop-lock at Troy (No. 29 of this list).....	Jan. 14, 1885	52 00
53.	Additional appropriation, improvement three-fourths miles north of Moseskill (No. 11 of the list).....	Jan. 14, 1885	796 07
54.	Additional appropriation, rebuilding culvert at Thorne's lane (No. 35 of this list).....	Sept. 26, 1885	361 27
55.	Additional appropriation, rebuilding waste-weir above lock 11 (No. 7 of this list)....	Sept. 26, 1885	188 00
56.	Additional appropriation, improvement at Mechanicville (No. 31 of this list).....	Sept. 26, 1885	582 00
57.	Additional appropriation, improvement near Finch & Pruyn's lime kiln on the Glens Falls feeder (No. 37 of this list).....	Sept. 26, 1885	1,040 00
58.	Widening and strengthening all narrow and weak points		

No.	DESCRIPTION.	Set aside by Canal Board.	Amounts.
	between Fort Ann and Fort Edward, by dredging.....	Sept. 26, 1885	\$6,000 00
59.	Improving four chains of canal on the berme side, situated about nineteen chains south of the road bridge at Smith's Basin, at the Keenan Lime Company's dock.....	Sept. 26, 1885	175 00

Total amounts set aside by Canal Board.. \$226,814 75

By resolution of the Canal Board, at a meeting held on the 14th day of January, 1885, the following appropriations, included in the above list, were rescinded:

1. No. 1 of above list in order that the money be applied to improvements more urgently needed elsewhere \$1,536 98
2. No. 9 of above list, for same reason as No. 1..... 1,725 00
3. No. 12 of above list, plan of work being changed and appropriation No. 32 being substituted therefor..... 8,660 00

Total..... \$11,921 98

DESCRIPTION OF EXTRAORDINARY IMPROVEMENTS ON THE CHAMPLAIN CANAL.

For a description of the thirty-nine improvements (Nos. 1 to 39 in table of amounts set aside by the Canal Board) authorized by resolution of the Canal Board prior to September 17, 1884, reference is respectfully made to my report for the year ending September 30, 1884, pages 61 to 64.

40. This improvement consists in building of sixty-six feet of vertical wall in cement on the berme side of the canal, between lock 8 and the waste-weir north thereof, and the strengthening of the berme by additional embankment back of the new wall.

41. This improvement is on the berme side of canal, beginning at the north end of berme abutment of the Broad street bridge in Waterford, and runs northerly about 250 feet, and consists in protecting the high cut on this side of the canal by a wall laid partly in cement and partly dry.

42. This improvement consists in strengthening the tow-path bank by means of additional earth embankment from a point two and one-half chains north of the center of Wilbur's Basin waste-weir, running northerly a distance of nine and one-half chains.

43. This work consists of strengthening fifteen chains of tow-path bank by means of additional earth embankment. It extended

from a point eleven and thirty-six hundredths chains north of bridge No. 79 to a point four and eighty-two hundredths chains south of bridge No. 80.

44. This improvement consists of strengthening six chains of the berme-bank by means of additional earth embankment over and on each side of culvert No. 14. It begins two and sixty-hundredths chains south of the center of the culvert, and extends to a point three and forty-hundredths chains north of said center.

45. This improvement is on both berme and tow-path sides of the canal, and consists of the building of eight and fifty-hundredths chains of vertical wall in cement on the tow-path side; the strengthening of ten and fifty-hundredths chains of tow-path by means of additional earth embankment, the widening of prism of canal so as to obtain a width of forty-four feet on bottom, the strengthening by additional earth embankment of five chains of berme bank and the consequent lengthening of the berme end of the culvert about thirteen feet.

46. This work consists of strengthening by means of additional earth embankment eight and forty-hundredths chains of tow-path bank, beginning at a point six chains north of the center of bridge No. 102 and thence running north.

47. This is for the rebuilding on an improved plan with wrought-iron lift-gates, of an old and very much dilapidated waste-weir, situated about two and one-half miles south of Fort Ann, and known as Empie's waste-weir, or waste-weir No. 17.

48. This work consists of improving the prism of the canal by deepening the bottom so as to secure six feet of water and widening it by rock cutting on the berme side, so as to obtain a width of not less than forty feet on bottom, beginning at a point at the north side of the berme abutment of first change bridge north of lock No. 4, and running north sixteen and one-half chains. The height of the rock cliff here prevents the obtaining of the full forty-four feet on the bottom of canal, but the improvement as contemplated will greatly benefit the canal and prevent the occurrence of wedges which have heretofore been quite frequent at this point.

49. This work is on the Glens Falls feeder, and consists of excavation of earth and rock from bottom of prism to the level of the miter-sill of the guard-lock, at the head thereof, and extends over a distance of sixteen and one-half chains. It is located near the guard-lock.

50. This is an additional appropriation for rebuilding waste-weir at Burton's mill, Waterford, rendered necessary by the fact that in order to get a proper foundation on rock for this structure, a portion of bottom of spillway-wall was placed four feet and a portion five feet below the level contemplated in the original estimate.

51. This is an additional appropriation for building the spillway between locks 5 and 6, rendered necessary by reason of a very soft

peat bottom being found, and recourse had to be had to forming an artificial foundation by the driving of piles and the puddling of gravel between them.

52. This is a small additional appropriation for the improvement of the sloop lock at Troy, the original estimate having been found insufficient.

53. This is an additional appropriation for the completion of the work of strengthening eight chains of berme bank and raising and lengthening parapet of iron pipe culvert three-fourths mile north of Moseskill, and the amount represents the difference between the preliminary estimates and the actual cost of the work.

54. This is an additional appropriation for completing the improvement of Thorne's lane culvert above lock 6, rendered necessary by the treacherous nature of the material through which excavation for culvert was made whereby an unavoidable increase in quantities over preliminary estimate made in the items of "excavation," "procuring" and "puddling" and "vertical wall laid dry."

55. This is an extra appropriation made to cover difference between preliminary estimate and final account for this work. The difference is mainly caused by the fact that in order to secure a more perfect structure, it was considered advisable to increase the quantities in the items of "puddle," "embankment," "lining and graveling" and "vertical wall in cement," and reduce quantity of vertical wall laid dry.

56. This is an additional appropriation for strengthening seven and one-third chains of the berme bank at Mechanicville, and the amount represents the difference between actual cost of the work and the preliminary estimate therefor.

57. This is an additional appropriation for completing the work of improving eleven and one-half chains of the Glens Falls feeder at Finch & Pruyn's lime kiln, Glens Falls, and was rendered necessary by the great difficulty encountered in making water tight the large fissures found in the bottom of the canal and at the base of the new vertical wall at this point, and also on account of the expenses incurred in stopping leaks east and west of this new wall.

58. This work extends all along the canal at detached points between Fort Edward and Fort Ann, a distance of twelve miles, and consists of widening and deepening the prism of the canal by means of dredging at such points as most urgently needed the improvement.

59. This improvement consists of widening four chains of canal, by earth excavation on the berme side, at a point opposite the docks of the Keenan Line Company, where an abrupt elbow jutting into the canal rendered navigation difficult.

Of the above the following have been contracted for, completed, and final accounts therefor rendered:

Nos. 3, 4 and 21, Sherman & McDonough, contractors.

Nos. 5, 6, 7, 8, 16, 17, 19, Chester Ray, contractor.

No. 13, Groton Iron Bridge Company, contractors.

No. 49, John C. Buckley, contractor.

Nos. 35, 36, 38, 48, Flood, Monty & Co.

The following have been completed by the Superintendent of Public Works:

Nos. 2, 10, 11, 14, 15, 18, 20, 22, 23, 24, 25, 26, 29, 31, 33, 34, 37, 41, 44, 46, 47, 59, at a cost of \$71,994.06.

The following have been partially completed by the Superintendent of Public Works:

Nos. 30, 32, 45 and 58, the amount expended thereon being \$2,102.20.

The following are to be done by the Superintendent of Public Works, but work thereon has not yet been commenced:

Nos. 40, 42 and 43.

The resolutions of the Canal Board, authorizing the following, have been rescinded:

Nos. 1, 9 and 12.

By act chapter 154, Laws of 1884, the Legislature appropriated the sum of \$6,000 for the construction of an iron highway bridge over the Champlain canal in the town of Watervliet, in the county of Albany.

A contract for the execution of this work was awarded to Flood, Monty & Co, Sandy Hill, New York.

By act chapter 360, Laws of 1884, the Legislature appropriated the sum of \$1,500, for the construction of an iron foot bridge to take the place of the then existing wooden structure, in the village of Whitehall.

A contract for this work was awarded to the Hilton Bridge Construction Company, Albany, N. Y.

Both of these contracts have been completed, the work accepted and final accounts rendered therefor. I hereto append a statement of final accounts rendered during the year for contract work done under the authority act chapter 97, Laws of 1882, and act chapter 301, Laws of 1884, making a general appropriation for the extraordinary improvements of the Champlain canal and Glens Falls feeder, and also a statement of final accounts rendered for contract work done under the authority of special acts of the Legislature directing the same.

STATEMENT showing final accounts rendered during year ending September 30, 1885, on account of work done under contract on the extraordinary improvement of the Champlain canal, authorized by act chapter 97, Laws of 1882, and chapter 301, Laws of 1884.

NAME OF CONTRACTOR.	Description of work.	Date of contract.	Date of final account.	Engineer's preliminary estimates.	Amounts set aside by Canal Board.	Amount of final accounts.	Excess of appropriation over final accounts.
Sherman & McDonough.....	Rebuilding Barton's waste-weir at Waterford.....	Feb. 12, 1884	July 14, 1885	\$4,442 25	\$7,006 65	\$6,748 44	\$258 21
Sherman & McDonough.....	Building spillway between locks 5 and 6.....	Feb. 12, 1884	July 24, 1885	2,826 25	5,387 77	4,918 09	449 68
Sherman & McDonough.....	Building seven bridge abutments.....	Feb. 12, 1884	Aug. 27, 1885	7,656 00	7,656 00	6,781 84	924 66
Flood, Monty & Co.....	Building a culvert, etc., twenty-two chains above lock 6.....	Oct. 9, 1884	Aug. 12, 1885	4,842 85	5,204 12	5,204 12	.....
Flood, Monty & Co.....	Rock cut above Waterford guard-lock.....	April 20, 1885	May 19, 1885	2,142 50	2,142 50	1,630 99	511 51
Flood, Monty & Co.....	Piling and stone filling near Coveville.....	Oct. 9, 1884	July 14, 1885	5,972 50	5,972 50	5,237 66	734 84
Flood, Monty & Co.....	Rebuilding waste-weir at lock No. 20.....	Oct. 9, 1884	Aug. 21, 1885	2,770 80	2,770 80	2,039 75	730 05
Chester Ray.....	Improvement at Stillwater.....	Feb. 11, 1884	Sept. 17, 1885	17,395 00	17,395 00	13,532 21	3,872 79
Chester Ray.....	Improvement at Coveville.....	Feb. 11, 1884	Sept. 17, 1885	26,306 00	26,306 00	17,088 53	9,217 48
Chester Ray.....	Rebuilding culvert at Fort Miller.....	Feb. 11, 1884	Sept. 7, 1885	3,366 00	3,366 00	3,803 74	.....
Chester Ray.....	Rebuilding waste-weir above lock 11.....	Feb. 11, 1884	Sept. 7, 1885	2,008 25	2,196 25	2,196 25	.....
Chester Ray.....	Improvement at first railroad bridge above lock 20.....	Feb. 11, 1884	July 14, 1885	6,576 00	6,576 00	6,416 33	159 67
Chester Ray.....	Improvement between bridges 139 and 140.....	Feb. 11, 1884	Aug. 17, 1885	10,625 10	10,625 10	9,878 70	746 40
Chester Ray.....	Improvement one mile south of Whitehall.....	Feb. 11, 1884	Aug. 12, 1885	2,594 60	2,785 01	2,778 82	6 19
Groton Iron Bridge Co.....	Improvement at foot of Glens Falls feeder guard-lock.....	Feb. 11, 1884	Aug. 6, 1885	2,016 00	2,016 00	1,666 91	349 09
John C. Buckley.....	Improvement of Glens Falls feeder at guard-lock.....	Jan. 20, 1885	June 17, 1885	2,268 75	2,268 75	2,267 06	1 69
Total.....	.....	.....	.....	\$103,808 35	\$109,653 96	\$91,609 93	\$18,044 02

STATEMENT showing final accounts rendered during the year ending September 30, 1885, on account of work done on the Champlain canal, under contracts authorized by special acts of the Legislature.

NAME OF CONTRACTOR.	Description of Work.	AUTHORIZED BY ACT OF LEGISLATURE.		Date of contract.	Date of final account.	Amount appropriated by the Legislature.	Amount of final account.	Excess of the appropriation over final account.
		Chapter.	Laws of.					
Flood, Monty & Co.....	Iron highway bridge at Arch st., Green Island.	154	1884	Oct. 9, 1884	April 18, 1885	\$6,000 00	\$5,949 07	\$50 93
Hilton Bridge Construction Co.....	Iron foot-bridge at Whitehall.....	360	1884	Mar. 21, 1885	May 23, 1885	1,500 00	1,425 00	75 00
Total.....	.....	....	....	.....	.....	\$7,500 00	\$7,374 07	\$125 93

I would respectfully recommend that the following improvements be made, and the amounts opposite each be set aside by the Canal Board therefor, engineering expenses included in each estimate.

No. 1. At the Wilcox (or Sarles) from bridge, at Coveville, about three miles south of Schuylerville, \$2,986.35. This improvement contemplates the building of 300 feet of slope wall on the tow-path side of the canal, from a point two and one-half chains north of the center of the arch culvert below the bridge, and running north; also the tearing down and rebuilding the berme abutment of the bridge, setting the same back so as to obtain a width of forty-four feet on the bottom of the prism; also the necessary earth and rock excavations on the berme side to obtain the width desired, raising and lengthening the approaches, and constructing a new wooden Whipple truss bridge of seventy feet ten inches clear span, and twelve foot roadway. This is for the completion of the slope wall on the south end of the work awarded to Chester Ray, February 11, 1884, but not fully completed by him. Also for cutting off the point of rock on the berme side at the bridge, which contracts the channel to a great extent, the same being now but thirty feet wide on the bottom. The widening of the canal at this point was not included in the estimate of work let to Chester Ray.

No. 2. On the berme side of the canal about three-quarters of a mile south of Fort Ann, over and on each side of a culvert \$4,175.63. This improvement contemplates the widening of the canal on the berme side by excavation, so as to obtain the width of forty-four feet on the bottom; the building of vertical wall in cement and strengthening the banks by means of embankment. Station 0 is on the inner angle of the tow-path, two chains south of the center of the culvert; stations run north; the prism excavation extends from station 0+50 to station 8+27. The embankment extends from station 0 to station 0+17. The vertical wall extends from station 1 to a point 345 feet north of the same, with a twist wall on each end of thirty-three feet, to connect with the present slope wall.

Remarks.

Dangerous leaks have occurred here; the present wall is a mere face, twelve inches thick, and the bank is composed of moulding sand.

CHAMPLAIN CANAL — DELAYS TO NAVIGATION.

Navigation on this canal has been uninterruptedly maintained during the season covered by this report, with the exception of one delay of forty-nine hours duration — July 11 to 13, 1885, on Glens Falls feeder. This was caused by a slight break between locks 5 and 6 on the Glens Falls feeder.

GLENS FALLS FEEDER.

This feeder is in better condition than it has been for years. The walls are in good repair, many bad leaks have been checked, structures are in good repair, and the prism between the guard-

lock and first change bridge below has been widened and deepened, improving navigation, and increasing the water supply by giving greater head for feeding the Champlain canal.

A bad point of rock extending far into the prism and interfering with navigation below the lock has been cut off.

GLENS FALLS FEEDER — LOCKS.

There is one guard-lock and thirteen lift-locks on this feeder.

No.	DESCRIPTION.	Feet, Lift.
1.	Lower lock.....	10
2.	} Combined locks.... {	10
3.		10
4.		10
5.	.....	10
6.	} Combined locks.... {	10
7.		10
8.		10
9.		10
10.		10
11.	.....	11
12.	.....	12
13.	.....	10
14.	Guard-lock at dam.....	

Lock 2.

The bottom should be concreted and have new floor.

Lock 3.

The upper gates should be renewed.

Lock 4.

The masonry at the head of this lock has settled and should be rebuilt.

Locks 7, 8 and 9.

Bottoms should be concreted and new floors put in.

The trunk of the sluice around the five combined locks is very much decayed and should be renewed.

This structure needs prompt attention. July 3, 1868, it gave way and much damage was done, causing a delay of four days. (See report of 1868, page 43.)

Lock 11.

Two lower gates have been renewed, and new floor timbers put in sluice at head of lock.

Bulk-heads at the head of locks 2, 3, 11, have been rebuilt. The masonry of all locks on the feeder should be pointed and the walls of all but 5, 11 and 14 raised, so that the danger of overflow would be prevented.

GLENS FALLS FEEDER — DAMS.

There is but one dam on this feeder. See Champlain canal dams.

GLENS FALLS FEEDER—CULVERTS.

There are three culverts on the feeder. All are in fair condition.

GLENS FALLS FEEDER—WASTE-WEIRS.

There is but one waste-weir on the feeder, located at Finch, Pruyn & Co.'s lime kiln, on the tow-path side. The masonry has been repaired and a bad leak on the lower side checked by means of a cut-off of clay.

GLENS FALLS FEEDER—BRIDGES.

The following bridges have been rebuilt during the year: Green's road bridge. The old iron structure was badly damaged by the falling of the berme abutments. Repairs should be made to the Haviland, Sherman and Glens Falls road bridges.

GLENS FALLS FEEDER—ABUTMENTS.

The berme abutments of Green's road bridge have been rebuilt. The abutments for most part are in good repair. A number should be repointed.

I would recommend that ditches be cut at the rear of the banks.

GLENS FALLS FEEDER—PRISM WALLS.

The prism walls are for the most part in good condition. Considerable pointing has been done on them.

About eleven and one-half chains of canal at Finch & Pruyn's lime kiln has been widened and a vertical wall in cement constructed. Very bad leaks have also been checked in the bottom of the canal at this point.

BREAKS.

There has been but one break on the Glens Falls feeder, causing a delay to navigation—from Friday, July 10th, at 8 A. M., to July 13th, noon. This break occurred at the head of the sluice on the berme side, between locks 5 and 6.

The water broke through the bottom of the canal, about twenty feet in front of the structure, cut under the puddle at the bottom and vertical wall at the lower end, leaving both suspended, carried away about twenty feet of embankment and cut under the foundation of the ends of the two wing walls. The structure and vertical walls have settled, no open joints were found nor could the smallest crack be discovered; the settling is greatest at the rear (end of wings), being about six inches lower than front.

The bottom is quicksand, sheet piling was driven in the prism and front of masonry, all spaces undermined were thoroughly filled with puddle, and the bottom and face of new filling in the prism well covered with gravel. Quicksand was encountered and gave much trouble.

ENGINEERING DEPARTMENT.

This division has for the past fiscal year been in charge of John R. Kaley, division engineer, and Chapman L. Johnson, acting resident engineer.

The work of the department has been as follows: Attending to the general routine of office work; making surveys, plans and estimates for the various pieces of work on the extraordinary improvement of the Champlain canal, heretofore detailed in this report, for which appropriations have been made by the Canal Board since October 1, 1884; supervising the building of the iron bridge, abutments and approaches on the Champlain canal at the continuation of Arch street, Green Island; the preparation of plans and specifications for the rebuilding of a foot-bridge over the Erie canal in the Lumber District in Albany; for the building of a new foot-bridge over the Erie canal at Middle street, West Troy; the building of a foot-bridge over the Champlain canal at Whitehall; the replacing of a wooden bridge over the Erie canal at Herkimer with one of iron; the preparation of plans and estimates for strengthening the State dam at Cohoes; the staking out and inspecting and supervising of all work done on the extraordinary improvement of the Champlain canal, and the making of monthly estimates for the portion thereof done by contract; the preparation of sixteen final accounts for work done by contract on the extraordinary improvement of the Champlain canal, and one final account for the construction of the iron bridge at Green Island, and one final account for the construction of the foot-bridge at Whitehall, amounting in all to \$98,984; making surveys, maps and descriptions of land for Board of Claims, for use in defending claims arising in Whitehall, Northumberland, Moseskill and Stillwater on the Champlain canal, and at Cohoes on the Erie canal.

A statement of the engineering expenses of this division is hereto annexed, showing in detail the names of persons employed, time of service, and compensation of each.

STATEMENT showing names, rank, number of days and compensation of engineers employed on the Eastern Division of the New York State Canals, together with incidental expenses, during the fiscal year ending September 30, 1885:

Ordinary repairs.—Erie canal:

John K. Kaley, division engineer, salary at rate of \$2,400.....	\$1,600 00
John R. Kaley, division engineer, travel..	21 30
C. L. Johnson, assistant engineer, 286 days, at \$5 per day.....	1,430 00
C. L. Johnson, assistant engineer, travel,	390 23
O. F. Balston, assistant engineer, 273 days at \$5 per day.....	1,365 00
O. F. Balston, assistant engineer, travel..	51 65

Martin Schenck, leveler, 166 days at \$4.50 per day.....	\$747 00	
Martin Schenck, leveler, travel.....	72 83	
Ed. E. Sweet, leveler, 102 days at \$4.50 per day.....	459 00	
Ed. E. Sweet, leveler, travel.....	38 55	
Martin Schenck, rodman, 27 days at \$3.50 per day.....	94 50	
Martin Schenck, rodman, travel.....	14 92	
Charles H. Whitbeck, chainman, 308 days at \$2.50 per day ...	770 00	
Charles H. Whitbeck, chainman, travel..	23 90	
		<hr/>
		\$7,078 88

Incidentals:

Clerk hire and labor.....	\$56 50	
Stationery	396 20	
Postage, telegraph and telephone.. . . .	88 85	
Miscellaneous	290 47	
		<hr/>
		832 02

Total for Erie canal.....	\$7,910 90
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Ordinary repairs — Champlain canal:

John R. Kaley, division engineer, salary at the rate of \$2,400.....	\$800 00
John R. Kaley, division engineer, travel.	250 31

Total for Champlain canal.....	\$1,050 31
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Extraordinary repairs — Champlain canal:

Charles A. Sweet, engineer in charge 163 days at \$6 per day.....	\$978 00
Charles A. Sweet, engineer in charge, travel.....	175 93
Garrie V. Rapp, assistant engineer, 161 days at \$5 per day.....	805 00
Garrie V. Rapp, assistant engineer, travel.....	133 84
James P. Campbell, assistant engineer, 152 days at \$5 per day.....	760 00
James P. Campbell, assistant engineer, travel.....	89 46
C. L. Johnson, assistant engineer, 27 days at \$5 per day	135 00
C. L. Johnson, assistant engineer, travel.	64 64
George I. Bailey, leveler, 313 days at \$4.50 per day.. . . .	1,408 50
George I. Bailey, leveler, travel.....	143 55

Ed. E. Sweet, leveler, 147 days at \$4.50 per day.....	\$661 50	
Ed. E. Sweet, leveler, travel.....	52 94	
G. D. Baltimore, leveler, 34 days at \$4.50 per day.....	153 00	
G. D. Baltimore, leveler, travel.....	10 55	
Charles R. Baldwin, rodman, 234 days at \$3.50 per day.....	819 00	
Charles R. Baldwin, rodman, travel.....	126 06	
Charles H. Barber, rodman, 190 days at \$3.50 per day.....	665 00	
Charles H. Barber, rodman, travel.....	67 68	
Thomas Murphy, rodman, 190 days at \$3.50 per day.....	665 00	
Thomas Murphy, rodman, travel.....	36 31	
Thomas Foley, rodman, 190 days at \$3.50 per day.....	665 00	
Thomas Foley, rodman, travel.....	7 90	
F. D. Lamouree, rodman, 195 days at \$3.50 per day.....	682 50	
F. D. Lamouree, rodman, travel.....	90 50	
Isaac Thomas, rodman, 96 days at \$3.50 per day.....	336 00	
Isaac Thomas, Rodman, travel.....	14 16	
Frank McCabe, rodman, 89 days at \$3.50 per day.....	311 50	
Frank McCabe, rodman, travel.....	13 19	
Henry Foley, rodman, 84 days at \$3.50 per day.....	294 00	
Henry Foley, rodman, travel.....	3 60	
Joseph Donelly, chainman, 124 days at \$2.50 per day.....	310 00	
Joseph Donelly, chainman, travel.....	28 13	
James Ryan, Jr., chainman, 67 days at \$2.50 per day.....	167 50	
James Ryan, Jr., chainman, travel.....	27 90	
		\$10,906 34
Incidentals :		
Labor.....	\$72 50	
Fuel and light.....	28 63	
Office rent.....	87 00	
Postage, telegraph, etc.....	55 57	
Stationary.....	142 94	
Miscellaneous.....	815 54	
		1,202 18
Total,.....		<u>\$12,108 52</u>

The above statements are summarized as follows :

Expended for ordinary repairs, Erie canal, from October 1, 1884, to October 1, 1885.....	\$7,078 88
Expended for ordinary repairs, Champlain canal from October 1, 1884, to October 1, 1885.....	1,050 31
Expended for incidentals, ordinary repairs, Erie and Champlain canals, from October 1, 1884, to October 1, 1885.....	832 02
Expended for extraordinary repairs, Champlain canal from October 1, 1884, to October 1, 1885...	10,906 34
Expended for incidentals, extraordinary repairs, Champlain canal, from October 1, 1884, to October 1, 1885.....	1,202 18
Total.....	<u>\$21,069 73</u>

MIDDLE DIVISION.

. ANNUAL REPORT OF DENISON RICHMOND, DIVISION ENGINEER, FOR
THE FISCAL YEAR ENDING SEPTEMBER 30, 1885.

SYRACUSE, N. Y., *October 1, 1885.*

HON. ELNATHAN SWEET,

State Engineer and Surveyor :

SIR.—In obedience to act chapter 169, Laws of 1862, prescribing the duties of engineers, I have the honor of transmitting herewith my annual report upon the Middle Division of the New York State canals for the fiscal year ending September 30, 1885.

The division embraces ninety-seven miles of the Erie canal lying between the east lines of Oneida and Wayne counties; also the following unabandoned lateral canals: The Black River canal and river improvement, the Oswego canal and Oneida and Seneca river improvement, the Cayuga and Seneca canal and all the lakes, artificial reservoirs and feeders, from and through which the water supply is obtained.

The following tables contain the data relating to the canals, river improvements and feeders; also water supply as far as measured:

Canals.

	Miles.	Totals.
Erie canal, from east line of Oneida county to east line of Wayne county.....	97.02	
Chenango canal, from Erie canal to lock No. 1...	.15	
Black River canal, Rome to Lyons Falls.....	35.33	
Old Oneida Lake canal, Higginsville to first lock..	1.05	
New Oneida Lake canal, Durhamville to Oneida lake.....	5.30	
Oswego canal, from Syracuse to Oswego.....	38.00	
North and south side-cuts and slips at Salina.....	2.00	
Slips at Liverpool, Oswego canal.....	.21	
Baldwinsville side-cuts.....	.75	
Cayuga and Seneca canal, Montezuma to Cayuga and Seneca lakes.....	22.77	
	<hr/>	202 58

River Improvements.

Black river, Lyons Falls to Carthage.....	42.50
Onondaga outlet, Onondaga lake to Seneca river..	75
Oneida river, Three River Point to Brewertown, Oneida lake.....	20.00

	Miles.	Totals.
Seneca river, towing-path, Mud lock to Baldwinsville.....	5.75	
Seneca river, Baldwinsville to Jack's reefs... ..	11.75	
Ithaca inlet, Cayuga lake to Ithaca.....	2.05	
Seneca lake outlet, from Cayuga and Seneca canal to Seneca lake.....	.26	
		83.06

Navigable feeders.

Limestone creek feeder, Erie canal to Fayetteville.	.80	
Butternut creek feeder, Erie canal to Feeder dam above Dunlap's Mills.....	2.00	
Nine-mile (Camillus) feeder, Erie canal to Camillus	1.00	
Delta feeder, foot of lock No. 9, Black River canal, to Delta.....	1.38	
Black river feeder, Boonville to head of pond at Forestport.....	12.09	
		17.27
Total.....		302.91

Artificial feeders, not navigable

	Miles.
Chenango canal, from lock No. 1 to lock No. 77.....	26.72
Leland pond feeder.....	.32
Madison brook feeder.....	3.00
West branch feeder.....	5.74
Bradley brook feeder.....	.65
Hatch lake feeder.....	.23
Kingsley brook feeder.....	1.93
Oriskany creek feeder.....	.53
Mohawk feeder at Rome.....	.05
Oneida creek feeder.....	3.04
Cowasselon creek feeder.....	.38
Chittenango creek feeder.....	.28
Cazenovia lake outlet (improved).....	.49
Tioughnioga river feeder.....	.70
De Ruyter reservoir outlet.....	.12
Butternut creek (Orville) feeder.....	.55
Nine-mile creek (Camillus) feeder... ..	.65
Carpenter brook feeder.....	.18
Skaneateles creek feeder.....	.10
Putnam brook feeder.....	.20
Centerport feeder.....	.24
Owasco creek feeder.....	2.10
New outlet, Third Bisby lake.....	.06
New outlet of Canachagala lake.....	.16
Total.....	48.42

WATER SUPPLY.

Erie Canal—Frankfort and Rome Levels.

($3\frac{356}{1000}$ miles of Frankfort level on Middle Division. The Rome level lock, No. 45 to No. 47 = $55\frac{257}{1000}$ miles.)

	Cubic feet per minute.
Leland's pond, Madison brook reservoir, Eaton brook reservoir, Bradley brook reservoir, Hatch's lake, Kingsley brook reservoir and Oriskany creek feed through the Chenango canal into the Frankfort level at Utica, half a mile east of lock No. 46, and through Oriskany creek feeder into the Rome level, six miles west of lock No. 46.....	6,000
Mohawk river, Black river, Forestport pond, White lake reservoir, Chubb lake, Sand lake reservoir, Woodhull reservoir, first, second and third Bisby lakes, North branch reservoir, South branch reservoir, and Canachagala lake. Twinn lakes feed through the Rome feeder and Black River canal into the Rome level at Rome, fourteen miles west of lock No. 46.....	13,000
Oneida creek enters the canal through feeder, thirty miles west of lock No. 46.....	1,000
Cowasselon creek enters the canal through feeder, thirty-one and one-half miles west of lock No. 46.....	200
Cazenovia lake reservoir (for 100 days), Erieville reservoir (for 100 days), and Chittenango creek enter canal through Chittenango creek feeder, forty-one and one-half miles west of lock No. 46.....	5,641
De Ruyter reservoir (for 100 days) enters fifty miles west of lock No. 46.....	3,891
Limestone creek, natural flow, enters canal fifty miles west of lock No. 46.....	500
Jamesville reservoir (for 100 days) enters canal fifty-two miles west of lock No. 46.....	2,000
Butternut creek, natural flow, enters canal fifty-two miles west of lock No. 46.....	500
Total.....	<u>32,732</u>

Short level, from lock No. 47 to No. 48 = $\frac{188}{1000}$ of a mile.
Fed from Rome level.

Mile level, from lock No. 48 to No. 49 = $\frac{714}{1000}$ of a mile.
Fed from level through Short level.

Syracuse level, from lock No. 49 to No. 50 = $5\frac{14}{1000}$ miles.
Fed from Rome and Jordan levels.

Jordan level, from lock No. 50 to No. 51 = $14\frac{408}{1000}$ miles.
Otisco lake reservoir enters canal through Nine-mile creek, (Camillus) feeder, four miles west of lock No. 50..... 5,146

	Cubic feet per minute.
Nine-mile creek, natural flow, enters canal through feeder, four miles west of lock No. 50.....	800
Carpenter brook enters canal through feeder, ten miles west of lock No. 50.....	200
Skaneateles lake reservoir feeds into canal at Jordan, thirteen miles west of lock No. 50.....	8,766
Total.....	14,912

Port Byron level, from lock No. 51 to No. 52 = $7\frac{798}{1000}$ miles.

Fed from Jordan level through lock No. 51.

Putnam brook feeder at Weedsport.....	200
Owasco lake reservoir through feeder at Port Byron.....	4,033
Total.....	4,233

Montezuma level, lock No. 52, to Wayne county line = $9\frac{28}{1000}$ miles.

Fed from Port Byron level through lock No. 52, amount from Lake Erie.....	4,000
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Oswego Canal.

Erie canal at Syracuse.....	10,000
Seneca river.....	54,000
Oneida river.....	20,000
Total.....	84,000

Cayuga and Seneca Canal.

Seneca Lake.....	18,000
Erie canal at Montezuma.....	4,000
Total.....	22,000

Black River Canal and River Improvement.

	Elevation in feet above tide water.	Surface area in acres.	Average area in acres.	Average depth in feet.	Capacity in cubic feet.
CANAL.					
White lake reservoir			296	5	64,468,800
Chubb lake reservoir (approximate)	1,599		200	4	34,848,000
Sand lake reservoir			306	15	199,940,400
Woodhull reservoir (two years in filling)	1,854	1,236	1,118	18	876,601,440
First, second and third Biaby lakes (approximate)				3½	40,000,000
Canachagala lake (approximate)			320	4	55,756,800
North lake reservoir (can fill twice yearly)	1,881	423	277	23	337,851,360
South lake reservoir	2,019	518	372	26	421,312,320
Twin lakes reservoir (approximate)			175	8	60,984,000
Forestport pond					
Mohawk river through Delta feeder					
Pond above Lyons Falls dam					
RIVER IMPROVEMENTS.					
Forge pond	1,691				
First lake of the Fulton chain	1,691				
Second lake of the Fulton chain	1,691				
Third lake of the Fulton chain	1,691				
Fourth lake of the Fulton chain	1,691				
Fifth lake of the Fulton chain	1,691	9			
Sixth lake of the Fulton chain	1,772	109			
Seventh lake of the Fulton chain	1,772	887			
Eighth lake of the Fulton chain	1,776	309			
Black river					
Moose river					

SUMMARY OF WATER SUPPLY.*Erie Canal.*

	Cubic feet per minute. Amounts.	Totals.
Frankfort and Rome levels	32,732	
Jordan level	14,912	
Port Byron level	4,233	
Montezuma level	4,000	
		55,877

Oswego Canal.

From Seneca river	54,000	
From Oneida river	20,000	
		74,000

Cayuga and Seneca Canal.

From Seneca river	18,000	
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Total water supply 147,877

The season of 1885, on this division, has been one of uninterrupted good navigation. All the canals opened May eleventh, five days later than last year. The full reservoirs assured an abundant supply of water at the outset, and the entire freedom of all the

canals from breaks or disasters of any description has been fortunate and is, no doubt, mainly due to the care and attention given by those in whose charge the maintenance of the canals are intrusted. While the work of bottoming out was not more extensive than usual, good judgment was used in selecting the points for removal where boats were found to have rubbed the bottom and, consequently, with a moderate expenditure, good navigation has been maintained. The displaced stone of the slope and vertical walls were generally put back and there is a marked improvement over last year in the appearance of all the walls above the water line, where most liable to disarrangement from the wash of steamboats or action of the frost. The four new gravel scows have been kept steadily at work, raising and strengthening the banks and graveling the tow-path, for which they were specially designed. The gravel filling and material excavated from the side ditches has been leveled with road scrapers and so placed as to give the best form to the tow-path. Sluices have also been built where necessary, and the condition of both banks have been greatly improved. This work should be continued until the banks are raised as originally intended, two feet above the surface of water. The prism would then be in a condition to receive from six to twelve inches more water with safety. The structures generally have been placed in good condition, especially upon the Erie canal, and there will be less than the usual number to rebuild next year.

Summary of Structures on Middle Division.

[illegible]

Ordinary repairs made during the fiscal year and repairs recommended—Erie Canal—Locks.

Lock No. 46.—Two new upper gates were put in the south lock.

Lock No. 47.—Two new lower gates were put in the north lock, and one in the south lock, and the foot-bridge over both locks rebuilt.

The pier at foot of lock should be rebuilt.

Lock No. 48.—The pier at foot of lock and foot-bridge over the south lock were rebuilt.

The pier at head of the lock should be rebuilt. Three of the lower gates need renewing and a new tumble-gate is required for the south lock.

Lock No. 49.—The two lower gates in the south lock have been renewed. Two more are framed, ready to put in the north lock.

Lock No. 50.—In the north lock a new lower mitre sill was inserted, the toe-posts and a balance beam in lower gates renewed, the spaces between the foundation timbers, from the chamber to the foot of the lock, thoroughly concentrated and a new floor and floor-binders placed upon this portion of the foundation. The pier at the head was repaired, fender plank placed upon the upper gates of both locks and upon the center gates of the south locks.

The vertical wall at head of south lock was rebuilt.

Lock No. 51.—The north pier of upper gates require new balance-beams and the foundation of both locks needs replanking.

Lock No. 52.—Needs one new balance-beam and a new foot-bridge, and the pier at head of lock should be rebuilt.

The machinery for hauling boats into the lock needs repairs, and the lock-house requires a new sill and new floor planking.

Aqueducts.

Oriskany aqueduct.—To stop leaks around the berme wings of this aqueduct, the earth was removed and selected material substituted, and puddled back, and the vertical walls in front of said wings taken down and rebuilt in mortar.

Cowasselon aqueduct.—The trunk sides were lined and the tow-path bridge including guard-rail rebuilt.

The trunk should be rebuilt.

Chittenango aqueduct.—The tow-path bridge across the aqueduct was rebuilt.

Limestone creek aqueduct.—The top portion of one of the berme piers is displaced, and requires replacing.

The cap on the berme side of the trunk needs renewing.

There is a leak at the south-east wing, and the vertical wall in front of the wing has settled. To stop the leak and insure against a break, the bank around the wing should be removed, and selected material puddled back and the vertical wall taken down, and relaid in mortar.

Jordan aqueduct.—The sides and bottom of the trunk should be replanked and a gravel bar under the trunk removed.

Centreport aqueduct.—The masonry was repointed and the bridge railing repainted.

The tow-path bridge needs new stringers and the trunk sides and bottom should be replanked.

Port Byron aqueduct.—The masonry has been repointed. The trunk needs replanking.

Crane Brook aqueduct.—The masonry has been repointed.

Seneca River aqueduct.—The exposed joints of the masonry have been repointed and two spans of the trunk at east end rewooded. The eleven westerly spans were rebuilt in 1882. The remaining eighteen spans require renewing. Timber for two spans is delivered.

Dams.

The wooden abutment of Oriskany dam was partially undermined by the spring freshet. This has been remedied by filling in solidly with loose stone where the material was washed away, and a heavy stone protection placed in front to prevent undermining.

Mohawk feeder dam.—Selected material should be filled in above the spillway of this dam, where the original filling has settled or been washed away.

The Limestone feeder and Nine-mile creek feeder dams have been repaired.

An earth dam, faced with brush and stone, was built and a new channel opened, turning Sauquoit creek where it threatened the destruction of the berme bank.

Culverts.

Composite culvert, west end of Kinley's farm bridge.—Owing to the displacement of the coping from the breast at the down-stream end of this culvert, the top portion of the trunk was exposed and the end timbers decayed, causing the parapet walls to settle. These walls were taken down, the decayed portions of the trunk renewed, the walls rebuilt and the breast restored and raised, so that the entire wooden trunk is now submerged, thus restoring the structure to a sound and safe condition.

Double arch culvert at Canastota.—The foundation plank at the south end of this culvert had become displaced, and the water falling over the high breast undermined the foundation timbers, allowing the wings and parapet walls to settle. The south-east wing had settled more than elsewhere in consequence of the failure of a cement pipe which permitted the water from it to pass down at the back side of the masonry and under the foundation, instead of discharging through an opening in the wing made for its passage. Dams were built, the water bailed out and concrete filled in between the timbers and thoroughly rammed under the foundation

and masonry. New plank were placed upon the timbers and secured by placing floor binders over the plank and drift-bolting them to the timbers underneath. A stone box culvert, laid in mortar, was substituted for the defective pieces of cement pipe in rear of the culvert wing and the retaining wall extending southward from the wing, along the east side of the creek, rebuilt in mortar.

The material in prism of canal over and around the arches was removed, places where leaks occurred stopped with concrete and selected material puddled back.

The exposed masonry joints of the majority of the culverts have been pointed during the year.

All the culverts upon this division of the Erie canal are now in good condition with a few exceptions.

The masonry at each end of the Whitehall composite culvert should be rebuilt, and also at that at the north end of Harbor brook culvert, the arch culvert between Main street and the aqueduct at Port Byron, and the composite culvert at west end of the division.

The wing and parapet walls of three culverts between Dunbarton and the State bridge need repairs, and the gravel bars under the arches of the triple arch culvert east of starch factory bridge should be removed.

Waste-weirs and Bulk-heads.

The waste-weir east of Higginsville is in an unsafe condition and should be rebuilt at once. The walls were too light as originally built.

The bulk-head of the waste-weir at Utica and the one east of Clark's farm bridge should be renewed.

Fort Bull waste-weir bulk-head needs additional bracing.

The waste-weir bridge over the double arch culvert at Durhamville needs rebuilding.

The Mohawk feeder bulk-head at Rome needs repairs.

The banks around Pool's brook waste-weir were strengthened, and the bulk-head at Cazenovia repaired.

The spillway at Drake's Mill, Montezuma, needs repairs, and the waste-weir over the feeder at Camillus should be rebuilt and lowered.

Bridges.

Parkherst's farm bridge, No. 30; Herring's road bridge, No. 46; Bennett's road bridge at Durhamville, No. 65; Fuller's road bridge, No. 72; May's Point road bridge, No. 145; the road bridge over Oriskany feeder, and the tow-path bridge over Wood creek, have been rebuilt.

Brainard's farm bridge, No. 29, Beaver street bridge at Jordan, No. 119, and the road bridge below dam at Jamesville, are being rebuilt.

Iron needle-beams have been substituted for wooden ones, and

the superstructures rewooded, in Catharine street bridge at Utica, No. 5, Whitesboro road bridge, No. 19, and Main street bridge at New London, No. 40.

James street bridge at Rome, No. 37, has been rewooded entire.

The wooden superstructure, No. 17, at Platt street Utica, was removed and an iron foot bridge is to be substituted.

The timber is framed ready for renewing Barnes' road bridge, No. 43.

Peterboro street bridge at Canastota, No. 68, Manlius Centre bridge, No. 82, Beech street, at Syracuse, No. 90, Canal street bridge at Port Byron, No. 137, Houghtaling's road bridge, No. 138, McLeod's road bridge, No. 139, and Salt street bridge at Montezuma, No. 141, have been replanked.

The roadways of John street bridge, Utica, No. 7, Washington street bridge at Utica, No. 11, Catharine street bridge at Syracuse, No. 92, and Orange street bridge at Syracuse, No. 93, have been replanked.

The roadway of Salina street swing bridge at Syracuse, No. 100, has been replanked and some of the floor joists were renewed. It needs replanking again.

Memphis road bridge, No. 115, was replanked and plank sidewalks placed on the approaches.

Hamilton street bridge at Jordan, No. 121, was replanked and two of the needle-beams renewed.

Hamilton's farm bridge, No. 132, was replanked and some of the floor joists renewed.

The roadway of Centreport road bridge, No. 133, was replanked and had some new floor joists.

Utica street bridge at Port Byron, No. 134, was replanked, some of the floor joists renewed and a guard-rail placed on the approach.

The west roadway of Broad street bridge at Utica, No. 4, was replanked. The east roadway needs replanking.

The sidewalks of Whitesboro street bridge at Utica, No. 14, were replanked and new floor joists inserted. The roadways need new plank and joists.

Bridge street bridge at Geddes, No. 106, the road bridge over Limestone creek at Manlius Centre, the swing bridge over feeder at Fayetteville, and Cazenovia outlet bridge have been repaired.

An iron bridge has been substituted for a wooden one over the inlet at De Ruyter reservoir, and another bridge over said inlet repaired.

The tow-path bridge over old feeder east of Rome has been repaired. It should be rebuilt or a stone box culvert substituted. and the tow-path built over it.

A majority of the bridge abutments have been repointed and a large number of the superstructures painted.

The iron bridge at Schuyler street, Utica, No. 16, and Owasco street, Port Byron, No. 136, need rewooding.

Hotel street lift bridge at Utica, No. 9, Stanwix road bridge,

No. 34, De Puyster street bridge at Rome, No. 36, Higginsville west road bridge, No. 58, Main street bridge at Canastota, No. 69, Genesee street bridge at Geddes, No. 105, and the swing bridge over the new Oneida Lake canal, need replanking.

■ The roadway of Clinton street bridge at Syracuse, No. 101, needs replanking.

The floor plank and joists need renewing in Breeze street bridge at Utica, No. 15, the tubular tow-path bridge over the Black river canal, the east approach to Washington street bridge at Rome, No. 38, George street bridge at Rome, No. 39, Higginsville east road bridge, No. 57, and the east tow-path bridge over the Oswego canal at Syracuse, No. 96.

Clinton street bridge at Whitesboro, No. 21, needs new plank for the roadway and new plank and joists for the sidewalk.

Christian's farm bridge, No. 27, Canal street bridge at Port Byron, No. 137, Houghtailing's road bridge, No. 138, and McLeod's road bridge, No. 139, need new floor joists.

First street bridge at Utica, No. 6, swing bridge over old Oneida Lake canal, No. 56, Herrick's farm bridge, No. 71, Burdick's road bridge, No. 86, Butternut creek feeder change bridge, No. 87, Thompson's landing road bridge, No. 88, Mulberry street bridge at Syracuse, No. 95, tow-path bridge over west entrance to Oswego canal, No. 97, Warren street bridge at Syracuse, No. 98, Gere's landing bridge, No. 100, Gere's farm bridge 110, Amboy road bridge, No. 112, Main street bridge at Jordon, No. 120, and Seneca street bridge at Weedsport, No. 128, need repairs.

Armstrong's farm bridge, No. 45, Stacey's basin road bridge, No. 53, Durhamville east road bridge, No. 63, Cold Spring road bridge, No. 122, and Hamilton's farm bridge, No. 132, should be rebuilt.

The span over roadway at Schoolhammer's road bridge, No. 66, should be rebuilt and the supporting bents renewed.

Bradley's road bridge, No. 25, needs new sway braces.

The chords of Clark's farm bridge, No. 33, need strengthening with iron straps at the splices.

The road bridge on berme No. 34½ needs a new timber abutment at west end.

The berme abutment of Jay street bridge at Rome, No. 40, should be rebuilt at once.

The private bridge at "Bone Yard," east of Syracuse, No. 89, is unsafe and must be taken down and removed or rebuilt at once.

OSWEGO CANAL AND TRIBUTARIES.

Aside from the general spring repairs, considerable work has been done to structures under water, requiring coffer-dams and pumping or bailing.

Several thousand lineal feet of old docking has been replaced with new timber.

disused), where it is turned into Black creek, from which it runs into the Genesee river and by it to the head of the feeder at Rochester.

Two miles from the above mentioned dam another exists on which is a spill-way 110 feet in length over which the waters of the creek flow whenever the reservoir is full.

The consumption of water on this division is very great on account of the amount of surface evaporation on so large a canal as that on Tonawanda creek, and between Lockport and Rochester, and the amount used by the locktenders in drawing boats into the locks and driving them out again.

This subject was treated on in full in my report of 1880, also last year.

During the last season no trouble has been experienced for lack of water to sustain navigation on any portion of this division, the raising of the banks on the western end of the long level, between Rochester and Lockport, and on the western end of the seventeen-mile level, and the consequent power to safely raise the surface of the water by a few inches, has had a very beneficial effect in this respect.

NAVIGATION.

No delays to navigation from any cause have occurred during the last fiscal year on this division.

DAMS.

There are three dams on this division besides those on the Oil creek reservoir, hitherto described. They are that at Tonawanda village, across Tonawanda creek; that across the same stream at the head of the feeder which turns the waters of the Tonawanda into the channel of the Oak Orchard.

Both of these dams are of the same construction, being composed of trees, brush and gravel, and are in good condition.

The one at Tonawanda village has a set of gates, twelve in number, four by five feet each, which are used in times of floods.

The other dam is situated at the head of the Genesee river feeder. It extends across the Genesee river and is 510 feet long; built of timber on a rock foundation, it has in its center eight piers of wood, with spaces between them, which allow in time of ordinary water the passage of the stream as though no dam existed. The

purpose of the dam is such that when these passages are closed, and the dam raised fifteen inches by means of flush-boards, the water in the river can be turned into the feeder.

This dam is in a very dilapidated condition and wants extensive repairs; both in regard to the woodwork and of the raising of the bank on the west end thereof and rip-rapping the same, as well as repairing and pointing up the masonry.

Locks.

There are twenty-three locks on this division. Of these nineteen are lift locks numbering from fifty-three to seventy-one inclusive, and are located from Clyde to Lockport.

They are 110 feet by eighteen feet in size. The lifts are all to the westward and vary from four feet nine inches to ten feet one inch in height. The five western ones at Lockport are combined and have a total lift of fifty-seven feet and five inches.

There is one guard lock at Sulphur Spring, about five miles above Lockport to guard the canal against floods in Tonawanda creek. It has a chamber 110 feet by twenty feet. It has two additional sets of gates at the side, which as well as the guard lock, usually stand open.

One river lock at Tonawanda village (single) 110 feet by eighteen feet; it is lift lock connecting the Niagara river at that point with the canal. The rise is generally about four feet, according to the height of the river.

One double chambered guard lock at Black Rock 112 by twenty feet. The lift here is generally two and a half feet, in accordance with the height of the water in the harbor.

Between these locks is a large bulk-head fitted with gates to regulate the water in the canal. This was thoroughly repaired last spring.

The total rise going west on the division from the Montezuma level to Lake Erie, is 180.35 feet.

Besides the above mentioned locks, there is a ship lock at Black Rock, connecting the harbor above the dam with the river below. It is 200 feet by thirty-six feet. The lift is generally about four feet.

There is also one weigh lock situated in Rochester. Since the canals were made free it has not been in use for weighing boats. It is found very useful, however, as a harbor for refuge for sinking

boats, and also for the purpose of repairing boats belonging to the State, in connection with the State yard at this point.

The masonry of the lift locks is generally in good condition, requiring attention to minor details of repairs, with the following exceptions: The south wall of lock 71 (the upper one at Lockport) has been thrust forward by the action of the frost and ice in the raceway to the south of it, and as some of the boats stick badly in this lock the face of the wall should be dressed off, and the hollow quoins dressed out so as to let the gates further back out of the way of the boats.

The wall between the race and lock 70 has been thrust forward in the same way as lock 71. It must shortly be taken down and relaid.

The walls on the north side, at the head of each of these locks, have also been thrust forward by the same elements. The material behind these walls should be removed, and loose stone laid in as a preventative against further displacement.

The mitre sills also, which were originally of stone, have become much broken up. They should be replaced by those of wood, or wood and iron combined.

The coping on the ship lock has been thrust back by the heavy barges in locking through and the next course of stone damaged to such an extent that quite a number of stone will have to be replaced by new ones, and the coping replaced.

In the month of July last a fire occurred just west of the lock at Tonawanda, which split about eighty feet in length of coping. It should be replaced by new coping which can be procured from lock No. 3, on the Genesee Valley canal, which was retained for repair purposes when the structures on that canal were sold.

The piers at the foot of locks 53, 54, 55, 57, 58, 59 and 60 need renewing wholly or in part.

The same can be said of those at the head of locks 57, 58 and 59.

New head gates were inserted in locks 54 and 71 last spring.

One pair are required for lock 71 and 65.

New gates were inserted at the foot of locks 62, two set; 63, two set; 65, one gate.

One pair are required at locks 53, 54, 57, 66, and one gate at lock 65.

Two tumble gates were made for lock 56, of which one was inserted.

One is needed for lock 64.

New platforms under tumble gates are needed on section 9.

Twenty new paddles were inserted on section 8 and ten on section 9.

The same number will be required next spring.

New mitre sills are required at locks 56 and 60.

The following locks require repairs to foundations, Nos. 53, 54, 57 and 60.

AQUEDUCTS.

There are four on this division, one each at Lyons, Palmyra, Rochester and Medina.

The two first mentioned have wooden trunks, the last mentioned are wholly of stone.

The one at Lyons is in good repair, needing only to be pointed up and to have one missing piece of coping replaced.

That at Palmyra should have a piece of vertical wall built on the west and on the berme side of about fifty feet in length. The timbers comprising the trunk are very much decayed and should, with a few exceptions be replaced by new ones. Several coping stone are missing and should be replaced.

Of those at Rochester and Medina, I beg to repeat what I have said before for several years, that they should be thoroughly pointed up, the one at Rochester have the bottom relined, this time with a thorough coating of Portland cement in place of one of a mixture of tar which was placed there ten years ago and which has since entirely decayed and become worthless.

That at Medina leaks very badly, especially on the towing path side, where it should have the earth dug out from between the walls, the masonry thoroughly grouted and pointed up, then the earth replaced with puddled materials and the whole made secure from percolation in the future.

These two fine structures are taking great harm by not having these things attended to.

WASTE WEIRS.

There are twenty-four waste weirs on the division.

Extensive repairs are needed to some of them.

On Nos. 1, 2, 3, 8, 15 and 20 the timber work requires renewing wholly or in part.

On No. 3 Lyons, some of the masonry requires to be relaid and about ten cubic yards of new masonry added thereto.

At the one at Cartersville a breast wall should be built to hold the water back so that at all times the floor timbers shall be covered to prevent decay.

On the following some of the stone are gone and requires to be replaced : Adam's Basin, Albion, Gasport and Lockport.

The wing walls of White's receiver, near Macedon, require to be relaid.

The Legislature having last winter made an appropriation of \$4,000 for the renewal of the waste weir at Eagle harbor, it has been let, the work of construction begun, it will be finished this year.

BRIDGES.

There are 220 bridges over the Erie canal, slips in Buffalo and elsewhere which belong to the State, three lift bridges which belong to the city of Rochester, viz., at Allen, Brown and Lyell streets, one truss bridge at Evans street in Buffalo, which belongs to that city. There are also two which belong to that city over slips, one of which, over slip No. 1, is too low and should be raised.

There are also a number of railroad bridges which cross the canal and slips at various points. One of these belonging to the New York Central Railroad over slip No. 1, in Buffalo, is too low ; it should be raised.

These two above mentioned bridges render the use of that slip impossible for canal boats whenever the water in the lake is above its normal height.

There also three wooden truss-bridges over the State ditch in South Tonawanda ; five of iron over the State ditches near that village ; one over the State ditch near the Sulphur Spring guard lock ; one over the Tonawanda and Oak Orchard feeder at the Batavia road, and one over the old canal at Knappville.

There are also fifty-one wooden farm road and bridges over the State ditches in Erie and Niagara counties, being one less than last year ; that over the military road in North Tonawanda having been replaced by a stone arch culvert of twenty feet span, during the past summer. It may be well to state that three other bridges over the same ditch in North Tonawanda should be replaced with similar stone arches as they become decayed and require renewing.

A wrought iron bridge with sidewalks was erected last spring at Pinnacle avenue, Rochester. It was paid for by special appropriation by the Legislature of the year before.

One was erected at Louisiana street, in the city of Buffalo, over the Hamburg canal, same width of, and in place of the one which fell down several years ago.

The following wooden bridges have been renewed during the last fiscal year: Nos. 40, 47, 57, 144, and the north spans of New Home, No. 173 and of Pickards, No. 174, both on Tonawanda creek.

The Big Bridge, so called, at Main street, Lockport, has been replaced by one of iron, it stretches 272 feet up and down the canal. It was paid for in part by a special appropriation of \$10,000 made by the last Legislature.

The following bridges will have to be rebuilt during the coming year: Nos. 3, 91, 100, 101, 141, 142, 143, 147, 162, 172 and the south span of New Home, No. 173, now framed and ready to raise.

No. 100 will be replaced by one of iron now in the State yard at Rochester.

No. 91 will be replaced by one of iron from Monroe avenue, Rochester.

The present Monroe avenue bridge, No. 63, will be replaced by one of wrought-iron, with sidewalks, the plan for which is made. It will be built the coming winter, the last Legislature having made an appropriation of \$9,000 therefor.

Cottage street bridge, Lockport, No. 162, will be replaced at once by one of iron similar in construction to that at Main street near by.

All the bridges have had the ordinary repairs made on them during the last season. The two swing-bridges in Rochester have been replanked throughout; the one at Exchange street had repairs made to the iron superstructure; it is now in good order.

The following have been replanked entirely: Nos. 17, 25, 46, 78, 113, 118, 122.

The bridge over the Clark and Skinner canal, at Ohio street, has been raised; that over the same slip at Elk street, is a foot too low, it should also be raised.

The superstructure of bridge No. 18, Lyons, should be put in order. Bridge No. 30, Port Gibson, should be placed on stone instead of wood, and several links now badly bent and out of shape should be straightened.

MASONRY OF BRIDGES.

The berme abutment of Pickard's, No. 174, was taken down, a substantial pile foundation made and the masonry rebuilt with stone from the State quarry at Black Rock.

WORK REQUIRED ON MASONRY OF BRIDGES.

The stone are on the ground to construct abutments for bridge No. 45, which is now supported by bents.

The masonry of the Culver road bridge, in the city of Rochester, has never been completed, the embankments are narrow and dangerous in consequence, and accidents have happened at this place, and are likely to happen again, as the travel over the bridge increases with the growth of the city. The embankments should be widened and lengthened.

New abutments of stone should be constructed at the towing-path bridge over the Scajaquada creek in Buffalo; the stone are on hand therefor.

The masonry of the south abutment of the towing-path bridge over the Tonawanda creek, at Pendleton, has been pressed forward by the action of the frost; it has been tied back with iron rods as a temporary expedient, it should be rebuilt.

The masonry of one of the abutments of the bridge over the slip to the river lock at Tonawanda should be taken down and rebuilt, as it also has been tied back to keep it from falling into the canal.

In the year 1880 I had an examination made of all the bridge abutments on this division, an account of all the stone which are missing made out and handed to the Assistant Superintendent of Public Works. As nothing has yet been done toward putting them in order, I have, at the solicitation of the present assistant superintendent, again gone over the same ground this year and find that the wings of the following bridge abutments will have to be relaid before the opening of navigation, the stone under water being displaced: Nos. 3, 6, 19, 21, 27, 29, 38, 41, 47, 48, 62, 124 and 138.

The following bridge abutments have stone gone therefrom, which will have to be replaced: Nos. 1, 2, 4, 5, 7, 8, 9, 20, 26, 35, 42, 43, 44, 46, 47, 48, 49, 50, 51, 54, 56, 57, 58, 59, 60, 62, 66, 67, 69, 76, 82, 83, 86, 87, 88, 89, 92, 93, 94, 95, 96, 97, 102, 103, 106, 111, 112,

115, 116, 124, 128, 134, 137, 138, 139, 144, 147, 153, 169, 174, 179, 183, 185, 202, 208, 211, 213.

The following bridges need to have coping and face stones relaid : Nos. 37, 40, 114, 128, 136, 140, 146, 148, 149, 151, 152, 166, 171, 175, 177, 184, 186, 188, 196, 200.

The following bridges should have the masonry raised: Nos. 27, 30.

A list of the stone required for this work, with the sizes of same and where needed, has been given to the Assistant Superintendent of Public Works.

All the bridge abutments require to be repointed in a proper manner.

At the following bridges the berme abutments should have piles driven in front of them, or have wooden piers filled with stone placed at the end of the wings, in such a way as to prevent light boats striking them when incapable of being steered by reason of wind pressure.

CULVERTS.

There are 136 culverts on this division.

No. 36, on the three-mile level, is partly of wood and partly of iron pipes, the wooden part, consisting of two openings, is open at each end and exposed to the action of the atmosphere. It is much decayed and should be replaced with iron pipes.

A culvert at Main street, Albion, has been a source of trouble through leakage. It is a stone box. It should be replaced by an iron pipe.

A small box culvert of stone under the Genesee river feeder should be replaced by one of wood, as it is always under water. The present one is a constant trouble from its leaking.

A culvert which conveys the water from the back ditch into the canal, just below the Sulphur Spring guard lock, has fallen in. It should be restored to its former usefulness.

The plank foundation of the large culvert under the canal, at the Irondequoit embankment, having been found defective it has been replaced this summer with two courses of two-inch plank. For further security, a breast wall should be constructed immediately below the foundation, to keep the same submerged at all times.

As in the case with the bridges, I have had a list made out of all the stone required to restore the wings and parapets of the

culverts to their original state. Very nearly all of them have been displaced by the action of the frost; they should be laid over, and as the same thing would occur again if not guarded against, I would recommend that for a distance of two feet from the rear of the masonry the earth should be removed and small stone substituted therefor.

On the following culverts some of the stone are gone: Nos. 2, 28, 30, 33, 34, 35, 36, 38, 40, 41, 42, 45, 46, 47, 49, 51, 54, 58½, 59, 62, 63, 65, 71, 77, 81, 82, 85, 86, 87, 94, 97, 100, 101, 103, 104, 108, 111, 125, 129, 131.

On the following the masonry should be taken down and relaid in consequence of displacement: Nos. 17, 19, 22, 26, 28, 31, 32, 33, 35, 38, 39, 40, 41, 42, 43, 45, 46, 47, 48, 49, 50, 51, 53, 55, 56, 57, 58, 58½, 59, 61, 62, 65, 67, 68, 69, 70, 71, 73, 74, 75, 76, 77, 78, 81, 83, 84, 85, 86, 87, 90, 91, 93, 96, 97, 98, 100, 102, 109, 110, 112, 113, 114, 116, 117, 119, 120, 122, 124, 128, 130, 131.

All the culverts required to be repointed.

STOP GATES.

There are six stop gates on this division, viz.: Two at Irondequoit and two at the Holley embankments, one at Adams' basin and one at the road culvert a short distance east of Medina.

The wood-work of the cribs of those on each side of the Irondequoit embankment, and the one at Adams' basin, is much decayed and needs renewal wholly or in part.

The stone work of all of them requires some repairs and pointing up.

VERTICAL WALLS.

The vertical walls in the cities and villages are very much out of order.

It is now nearly or quite thirty-five years since most of them were built. Time and frost, the great elements of decay in walls of this description, in this severe climate, have done their work on them. They should, for the most part, be relaid and when that is done should be supplemented with new stone and made heavier.

In those on the mountain ridge between the rock cutting and Pendleton many of the stones have decayed by the action of the elements and crumbled away. Here a large amount of repairs are needed.

Repairs have been continued on these walls through the city of Buffalo and new docking placed on them. Much is yet needed, notably, on the division wall between the canal and the harbor, which is in an incomplete state and should be finished.

The wall at the foot of the Lyons lock was completed last spring. This improvement consisted of widening the canal around a very sharp bend and replacing the slope wall with a vertical one, making it both safer and easier for the passage of "double header" boats.

A portion of the wall on the south side of Commercial slip in the city of Buffalo, has fallen in. It should be replaced on a good and sufficient pile foundation.

During the season several pieces of vertical wall have fallen in on the line of the canal between Buffalo and the guard lock at Black rock, pile foundations have been driven and the walls replaced; also at the foot of the guard lock 125 feet in length.

In the bed of the Genesee river, below the aqueduct, very good stone can be quarried during the summer months suitable for building vertical walls on land belonging to the State, doing this would at the same time lower the bed of the river and make a better water way, a thing to be desired in case of heavy floods.

SLOPE WALLS.

As a general thing those east of Rochester are in good repair, but west of that city they are badly out of shape, the soil is a mixture of clay and quicksand particularly susceptible to heaving by the frost, the absence of gravel for lining behind these walls on this portion of the canal is to be deplored.

CANAL BANKS.

The work of raising and strengthening the banks on this division has been continued during the past year, in consequence several inches more water has been carried on the west end of the long level between Rochester and Lockport and of the seventeen-mile level, to the advantage of navigation.

On the Montezuma level so much has been done on this division towards raising the banks, that more water could be carried if that portion of the level which lies on the middle division, was in as great a state of forwardness. This, when six inches more water is arrived at on this level, will greatly facilitate the passage of boats,

especially in entering the Port Byron lock, by giving more space between the mitre sill and the bottom of the boat. One hundred feet in length of sheet piling protection was put in at Bushnell's basin.

BORROW AND GRAVEL PITS.

In order to facilitate the above mentioned work of raising the banks and for gravelling the towing-path, appropriations have been made of land as follows:

	Acres.
In the town of Galen, Wayne county.....	1.73
In the town of Palmyra, Wayne county.....	.48
In the town of Pittsford, Monroe county.....	2.00
In the town of Ogden, Monroe county.....	.93
In the town of Lockport, Niagara county.....	.33
In the town of Pendleton, Niagara county.....	.30

Making a total of 5.77 acres, aggregating about 100,000 cubic yards of material.

Additional facilities in procuring materials from some of the old gravel pits could be arrived at by dredging a channel up to the face of the bank, in cases where it is now too far off, for convenient loading of boats.

TOWING-PATH.

The work of improving the surface of the towing-path has been carried on during the last fiscal year, both by the use of wheeled scrapers in levelling it off, and the boating on of gravel.

On Tonawanda creek the work of rip-rapping the face of the towing-path has been continued, the bank raised and covered with cinders or gravel; a portion at Pickard's has been piled and docked anew for changing teams.

DOCKING.

A very large amount of docking is badly decayed, in many places it is entirely gone, witness on the vertical walls of the slips and on the division wall in Buffalo, in the deep cut above Lockport, on the berme side-walls in the different villages, and in the city of Rochester; in consequence of this much of the wall is in bad condition.

PRISM OF THE CANAL.

The filling in of the canal with silty matter is still going on, greatly in excess of the amount taken from it during the annual spring repairs.

In 1876, at which time a survey of the canal was made and soundings taken its whole length, an estimate based on those soundings through this division gave the accumulations at 544,000 cubic yards of material. It may safely be put at 800,000 cubic yards at the present time.

This large amount of material constantly accumulating would seem to need more effectual modes of removal than that of manual labor in the spring.

Steam dredges are successfully employed on other canals. The method employed on the Illinois canal is said to answer the purpose, which is to dredge the material and to dump the excavated material into boxes on boats, which are then taken to a steam derrick and emptied over the canal bank where embankment exists. See my report of 1881. Another dredge on the division would be needed for this purpose, as the harbors, slips and canal in Buffalo require the constant work of the present dredge.

BIRD ISLAND PIER.

The work of making a foreshore of large stone in front of the wooden extension of this pier has been progressed.

On that portion extending below Bird island to Ferry street requires extensive repairs, the yearly grinding of the ice against it removes many of the stone from their places into deep water and they have to be replaced.

ERIE BREAKWATER.

No work has been done in the way of repairs on this structure during the last fiscal year.

BUFFALO TRUNK SEWER.

This has been completed so as to carry the dry weather flow from that portion of the city lying to the south and east of the outlet at Albany street into the Niagara river, it is a sewer of eight feet diameter.

That portion of the city lying to the north and east of the outlet, which is tributary to the Bird avenue sewer and whose sewerage still runs into the canal will have its dry weather flow conveyed to the same outlet by means of a sewer of four feet diameter which will tap the Bird avenue sewer near its mouth and thence be laid along the rear of the towing-path to the outlet at Albany street.

The sewer commissioners propose to let this work at once.

When this is completed the dry weather flow of the whole city will be conveyed to one point and emptied into the Niagara river with the exception of the islands comprised between the Hamburg and Erie canal, and the creek and harbor, the sewerage from this portion should be pumped up so that it will flow into the trunk sewer.

For some reason, perhaps because this island sewerage is not so pumped up, the trunk sewer does not seem to have the desired effect of relieving the nuisance of the Hamburg canal which is nearly as bad as it was before the sewer was completed, notwithstanding it is connected therewith at three different points, the city still keeps an engine and pumping apparatus renewing the water in the Hamburg canal, which may be esteemed a useless expense after the sewer was completed and brought into use, provided it had capacity to take off a sufficiency of the Hamburg canal water in addition to the dry weather flow to keep it from pollution.

STATE SHOPS.

At Rochester, a carpenter shop, eighty feet by thirty-six feet, of two stories in height, a blacksmith shop, fifty feet by thirty feet, a timber shed, seventy-two feet by forty-six feet, have been constructed during the last fiscal year.

In them have been placed all the machinery necessary to construct the wood and iron-work of bridges and lock-gates in a most economical manner.

In the carpenter shop is a Daniels planer, capable of dressing timber sixty feet in length, a mortising and a tenoning machine, two cross-cut and two slitting saws, large and small, and a boring machine.

In the blacksmith shop, a punch and shears, drilling machine and nut and screw-cutter, fan for blacksmith forges and a grindstone.

The whole is driven by a turbine wheel forty-four inches in diameter, fed by water from the canal. It has a power of from twenty-five to fifty horse-power, dependent on the difference in the levels of the waters of the canal and river.

I have, as heretofore, in my yearly reports, given an account of the large amount of work necessary to be done to restore completely the canal on this division, a condition which it would be true

economy to have throughout the entire length of this important link in the great water-way of the continent, it would be well if the State would copy the efforts of its great rivals, the railroads, in keeping its works in first-rate condition by placing enough money every year at the disposal of the Superintendent of Public Works to gradually bring about this much desired state of things, as it is easily to be seen that the present amount is not enough to prevent gradual deterioration.

This division has been under the charge of Thomas Evershed, as Division Engineer, and John Bisgood, as Resident Engineer, during the last fiscal year.

I have the honor to be your obedient servant,

THOMAS EVERSHED,

Division Engineer.

STATEMENT giving names, rank, number of days and compensation of engineers upon the repairs of the Western Division of the New York State canals, with incidental expenses, during the fiscal year ending September 30, 1886, under act chapter 169, Laws of 1863.

ERIE CANAL.

Repairs from October 1, 1885, to September 30, 1886.

NAMES.	Rank.	Number of days, etc.	Rate of compensation.	Total amount.
Thos. Evershed.....	Division engineer.....	Salary.....	\$2,400 per annum....	\$2,400 00
Thos. Evershed.....	Division engineer.....	Expenses..		363 44
John Blagood.....	Resident engineer.....	Salary.....	\$2,000 per annum....	2,000 00
John Blagood.....	Resident engineer.....	Expenses..		281 66
G. P. Hilton.....	Draughtsman.....	Plans.....		59 75
R. R. Stuart.....	Leveler.....	14.....	\$4.50 per day.....	63 00
R. R. Stuart.....	Leveler.....	Expenses..		73 96
George I. Bailey.....	Leveler.....	269.....	\$4.50 per day.....	1,210 50
George I. Bailey.....	Leveler.....	Expenses..		66 82
M. W. Wilbur.....	Rodman.....	813.....	\$3.50 per day.....	1,095 50
M. W. Wilbur.....	Rodman.....	Expenses..		155 86
Joseph B. Barrett.....	Chainman.....	813.....	\$2.50 per day.....	782 50
Joseph B. Barrett.....	Chainman.....	Expenses..		140 16
				<hr/>
Stationery.....			\$79 11	\$8,693 15
Fuel, light and office rent.....			402 20	
Postage and telegraph.....			55 81	
Miscellaneous.....			83 33	
				<hr/>
Total.....				\$9,263 60

Between lift lock No. 11 and guard-lock No. 4, several hundred lineal feet of vertical wall has been substituted for old docking. About as much more should be put in another year, connecting with this and extending northward.

Locks.

Lock No. 1.—Has had one new lower gate. The other three should be renewed.

Lock No. 2.—Needs one new balance-beam.

Lock No. 4.—New docking and vertical wall was put in at head. A new mitre-sill is needed.

Lock No. 5.—Needs new docking at foot.

Guard-lock No. 1.—Needs new gates.

Lock No. 6.—Needs repointing.

Lock No. 7.—Was pumped out and the floor lining and mitre-sills renewed. Two large pumps were constantly required, as there were nine feet of water over the floor, and the coffer-dams could not be located so as to cut off the leakage from the river coming from under the walls and through the side cribs. The lock needs two new lower gates.

Guard lock No. 2.—Needs repointing.

Lock No. 8.—Needs repairs to lower gates.

Lock No. 10.—Needs one new balance-beam.

Lock No. 11.—Needs repointing.

Lock No. 13.—Needs two new balance-beams.

Lock No. 15.—Needs one new balance-beam and guard-rail.

Guard-lock No. 5.—Needs three new balance-beams.

The wood lock at Baldwinsville is old and poor.

Dams.

The sloping apron to Phoenix dam should be completed, as the old flat apron is nearly gone and the dam is in danger of being undermined. About 160 lineal feet of new apron will be required. Bills of timber and iron have been given for this work.

The sloping apron should also be completed at the Van Buren dam another year; 287 lineal feet will be required. This will complete the sloping aprons as far as now appears to be necessary.

The docking at the head of high dam and crib at foot needs rebuilding.

The wooden dam at Baldwinsville requires annual repairs to the portion that has never been rebuilt.

Bulk-Heads.

The bulk-heads, six in number, at each end of the Phoenix dam have been completed.

The bulk-heads at the west end of the Fulton dam have also been rebuilt. To do this work required the use of the State dredge to remove the sunken timbers and flood-wood at the site of

the proposed coffer-dam just above the old framework. The coffer-dam was built in fourteen feet of water and guarded a clear opening of fifty-five feet after the old structure was removed. Extra precaution was taken with the temporary dam, as any failure under such a head would have allowed a body of water to wash through, destructive to everything below and difficult to control. Good success attended the work, and an entire new and substantial bulk-head was substituted. New mitre-gates were put in at the side lock and all the masonry repointed.

Bulk-heads at both ends of Oswego dam, west end of Oswego Falls dam and east end of Fulton dam should be rebuilt.

The renewal of the above will complete the river bulk-heads.

The heavy body of ice that moves out when the river breaks up endangers these structures if weakened by decay.

Sluices.

Seven sluices have been rebuilt or repaired. Nineteen others are old, and some should be rebuilt another year.

Two spillways have been abandoned and filled up.

The following bridges have been rebuilt:

Third North street, over north side-cut, including new timber abutments, Bridge street bridge, Phoenix road and change bridge, Phoenix road bridge at Hinmanville, Littlefield change bridge and Oak Orchard swing bridge.

The following bridges have had either entire new floors or repairs to the same:

James street, Wilson street, Bear street, Geddes road, Spring street, Green Point, Mud lock and Nos. 11, 16, 22, 23, 25 and 26.

The tow-path bridge over the entrance to the abandoned dry-dock at Syracuse has been taken down, and the approaches removed to the level of the tow-path.

The following bridges are recommended to be rebuilt:

Avery's bridge at Sixth North street over north side-cut, Tow-path bridge below lock No. 3, State Ditch bridge, foot-bridge at Liverpool, Platt street, Fulton.

Hubbard street bridge at Oswego needs repairs to truss and new floor. Bridges Nos. 7 and 24 need repairs to floor.

Oneida Lake Canal.

Two bridges have been abandoned and new temporary crossings made for the convenience of the farmers.

The bridge at South Bay cannot be lowered to advantage and should be rebuilt.

Cayuga and Seneca Canal.

But little bottoming out was done, but the dredge has worked during the summer on the Cayuga level, in the Geneva harbor and at Preemption bridge.

Some new docking has been put on and the tow-path repaired. Considerable labor has been required to keep the channel free from eel-grass, which is particularly troublesome on this canal.

Locks.

Eleven locks have been repaired but no entire new gates inserted. The bottom of lock No. 5 was cleaned out and four other locks were repointed.

New upper gates are needed at locks Nos. 3 and 4.

Locks Nos. 3, 6 and 8 will require pumping to repair sides and repoint below water.

The lining of lock No. 11 and the docking at locks Nos. 1, 2, 7 and 8 is poor.

Dams

The old wooden dam at Waterloo has been replaced with a substantial new stone structure 190 feet in length, located on a smooth rock foundation, immediately below the old one. A new bulk-head with stone abutments was also constructed. The leaky and unsafe condition of the old dam had been a source of annoyance for many years.

De Mont's and Burn's dams have been repaired.

Two spillways and one receiver have been repaired and one spillway rebuilt.

The bulk-head to spillway at Seneca Falls is old and unsafe.

Bridges.

Five towing-path spans over the river at Seneca Falls were rebuilt; also two spans over the canal basin in the same village.

Bridges Nos. 2, 3, 4, 5, 6, 10, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 24 and 25 have been repaired with new plank and joists.

Tow-path bridge No. 6 needs new pile fenders and docking between lock and bridge.

Bridges Nos. 14 and 16, over river, and Locust street road and change bridge should have some repairs.

The iron bridges generally need painting.

The piers at Geneva require some new timber to place in perfect repair, and the pile docking in the same village is generally more or less damaged during the winter. Its reconstruction on a more permanent plan is recommended.

Black River Canal.

The work of bottoming out and general repairs to prism was prosecuted during the three weeks immediately preceeding the opening, including the removal of a landslide in the Forestport feeder near Forestport, and forty feet of docking caved in at Rome.

Navigation has been interrupted but a few hours, caused by the failure of a sluice at lock No. 64.

A slide 150 feet in length, on the towing-path side of the For-
[Assembly No. 44.]

estport feeder, came near causing a breach, but was promptly repaired, and made secure by driving piles at the toe of the bank and loading with gravel.

The dredge has been in constant use on the river sections and has maintained a good channel throughout the season.

The repairs of the locks and bridges are the principal items of expense on this canal.

Locks.

All necessary repairs were made to the 109 canal locks, including the insertion of forty-one new lock-gates and many new mitre-sills and balance-beams. Others have been framed at the shops ready for insertion, and timber delivered for future use.

Bush's lock on the Black river has been completed, the west side having been rebuilt entire from low-water line. Four new gates were also inserted, and the timber docking at the lower end renewed and the walls repointed.

The walls of locks Nos. 12, 48, 60 and 76 should be taken up and relaid six or eight feet from the top.

New hollow quoin stone will be required for three or four locks.

The wooden river lock at Otter creek should be rebuilt from low-water line within a year or two. One new gate will be necessary next spring.

The high timber docking below lock 109 at Lyons Falls is in a dilapidated condition.

Many of the locks require bracing during the winter to keep them from being crowded in by the frost. Some dressing off, however, is generally required each year, particularly at the jaws of the locks.

Locks Nos. 1 and 29 required dressing this spring.

The work of repointing the masonry having proved successful, was continued this year, and material delivered to carry on this work.

Bridges.

There are seventy-nine bridges over the canal and feeders, and nine bridges, composed of several spans each, over the rivers, five of the latter being provided with swing superstructures, having each clear openings of fifty feet.

Many of the bridges have been partially rewooded and painted, and the approaches to several raised.

The following have been rebuilt entire: An iron chord in place of the old wooden road bridge over the old feeder lock at Forestport, including new stone abutments; also, the Manchester, Stephon's, Yerdon, Comstock, Hicks' Mills, Wilcox, Crowell, change bridge near Delta feeder and bridge at Lyons Falls.

Two spans over the Beaver river, at Naumburgh, have been completed.

The following bridges should be rebuilt: Courtney, Owen, Floyd, Davis, Thomas street, Rome, Utley, Brayton and Parker's swing.

An iron truss, now on hand, is to be erected at Hawkinsville, resting on stone abutments. Stone for the same are delivered.

One span of the Moose river bridge needs repairs.

Aqueducts.

The trunk to Wells creek aqueduct has been completed and abutments repointed, new timbers were put in aqueduct above lock 13, and the tow-path bridges to Lansing Kill and Mohawk aqueducts repaired. One span of the Sugar river aqueduct needs rebuilding

Culverts.

Culverts at A. Hall's and at lock 21 require annual attention, particularly the former, as large quantities of slate and flood wood is washed down from the adjacent hills and lodges in the paved channel, 600 feet in length, above the culvert, and has to be removed. This is the most troublesome culvert on the canal, as the damming up of the water is liable to cause breaks in the canal banks.

The covered sluice in the village of North Western has been cleaned out and rebuilt.

Reservoirs.

The bulk-heads have been rebuilt at Skaneateles reservoir dam. The old bulk-heads had been strengthened, but it was thought advisable to renew them, although the lake was higher than usual and substantial coffer-dams would be required. Great damage would have resulted, both to the canal and private property, if these structures had failed. The work was thoroughly done, including repairs to the hoisting power and a thorough repointing of all the masonry with Portland cement.

The coffer-dams also enabled us to cut off a leak that had been troublesome and caused some concern to the parties along this stream; although it had not been considered dangerous by the engineers.

The paddle gates of the South lake reservoir leaked so badly that the reservoir did not fill. These will be repaired as soon as the water is emptied for canal purposes.

Madison brook feeder has had a general cleaning out. The big feeder through which the water from the Madison group of reservoirs is fed should be bottomed out.

One of the valves of the De Ruyter reservoir was repaired after the water was drawn down and the well-house placed in good order, the dampness having decayed the inside woodwork.

SPECIAL APPROPRIATIONS.

Lengthening Lock No. 50.

Act chapter 80, Laws of 1884.

This work was prosecuted with vigor, commencing immediately after the close of navigation and finishing in time for the opening. Although more work was done than was originally contemplated, in improving the entrance below the lock by extending the foundation across the canal and substituting vertical walls, the cost came within the limits of the amount appropriated. The plan adopted involved the lengthening of the berme lock to double its original length, or 220 feet between quoins, the extension of the culvert and protection of the exposed side of the lock and culvert with a substantial wooden crib, filled with stone. The original rock did not rest upon piles, but after a careful examination of the ground below, it was decided to use them for the foundation of the new structure, as only a slight settlement might make a bad union with the old masonry. The walls were built of grey limestone taken from the same quarry that furnished the original lock, and the courses were generally matched in thickness and in the manner of dressing, making it in every way equal to the old work. The lower gates were left intact and now act as middle gates when it is desired to use but one chamber for single boats.

The water wheel and machinery in use on this division for assisting boats was remodeled and attached in such a manner that boats can be drawn into and out of either of the three locks. No delay, therefore, is possible in entering or leaving when the new lock is used for either double or single boats. The verdict of the boatmen has been universally in its favor, with an express wish that other locks might be similarly improve at the earliest moment.

Forestport Dam and Reservoir.

Act chapter 452, Laws of 1883.

During the fall of 1884 work was done amounting to about \$15,000. The necessary buildings were erected and much preliminary work done. The ground in the vicinity of the dam was grubbed and cleared and the pit for the bulk-head and paddle trenches excavated nearly to the depth required. This excavation was little better than a mass of boulders that required blasting. The stone, however, so obtained can be utilized in filling the cribs and for stone protection at the ends of the dam. A road, one-quarter of a mile in length, was constructed to the nearest clay bank, where a plentiful supply of suitable material for puddling purposes can be obtained. Ditches were also dug to drain the work. About 600 cubic yards of stone were quarried, dressed and delivered at the work or conveniently placed on the bank of the Forestport pond. The amount is less than one-half of the required quantity. The engineers' estimate for this reservoir, exclusive of land damages

and clearing flow ground, was \$55,000; this included the raising of roads and bridges; \$20,000 only was appropriated. The necessity for this reservoir has been stated in previous reports, and a further appropriation is confidently looked for, it being the most convenient and available source from which to obtain an adequate supply at all times for that portion of the Erie canal extending from Syracuse to Little Falls.

Reservoir on Beaver River.

Chapter 366, Laws of 1881, chapter 351, Laws of 1884.

These laws provided for reservoirs on Beaver and Independence rivers, but it was decided to build but one dam, and Stillwater on the Beaver river was selected as the best location. This point is in Brown's tract, twenty-nine miles by road from Lowville. It is proposed to build a wooden dam, 350 feet long and about ten feet high. No flow line has been run, but from levels taken up the river several miles, it is estimated that several thousand acres will be flowed. The ground for the dam has been grubbed and cleared, and about 850 cubic yards of boulders and earth excavation done. The pit for the bulk-head foundation is nearly completed. The south crib is in position, and about 100,000 feet, board measure, of timber hewed and delivered, and 116 trees cut and delivered for the spillway. A new road leading from the main road to the dam has been built and other preliminary work done. It is probable that operations will be suspended when winter sets in, as the river will be too high for continuing the work to advantage.

Iron Pipe Sewer under the Erie Canal at Utica, including Coffer Dam.

Chapter 119, Laws of 1885.

The date of contract for the above work was April 22, 1885, eighteen days before the time fixed for opening the canals. It called for the furnishing and laying of 300 lineal feet of forty-eight-inch cast iron pipe extending through the tow-path bank and up the Miller basin; also a coffer-dam across the basin, 100 feet in length, near the upper end of the pipe. This was done to allow the city of Utica to extend the sewer during the summer. The lower end was also left far enough away from the canal to allow its extension at any time. The upper end of the pipe was provided with a bulk-head, by which the basin could be drained, and a spillway built in the coffer-dam to carry off the water of the creek after heavy rains. The work was pushed as rapidly as possible, and although some difficulties were encountered by reason of the many sunken boats that had to be removed, or cut through, it was completed in due time, and the city is now completing the sewer. The old basin had been the receptacle of much filth, and the building of this sewer became a necessity.

Lowering the Columbia and Fayette Street Bridges over the Chenango Canal at Utica.

Chapter 482, Laws of 1884, and Chapter 80, Laws of 1885.

Under the last appropriation a new plan for this work was prepared, substituting stone culverts of eight-feet chord, extending the entire width of the street, and the Columbia street bridge placed under contract, while the Fayette street bridge was done by the State, under the direction of the Superintendent of Public Works. Both structures are substantially completed; and have improved the appearance of the streets, and by the removal of the approaches greatly accommodated the traveling public. The appropriation was found to be sufficient, except a small balance that will be paid by the city of Utica for a quarried stone pavement, subsequently substituted in place of the cobblestone, in use at the time the estimate was made.

Completion of Catherine Street Bridge over the Erie Canal in the City of Syracuse.

Act Chapter 205, Laws of 1885.

This appropriation is for the completion of the approaches to an iron bridge erected in 1874, at which time the superstructure and abutments were completed, but not enough funds were provided to build the necessary approaches and retaining walls. The adjoining owners objected to the approaches as originally proposed, but a compromise grade has been agreed upon, and its early completion will benefit residents in the vicinity, especially in the way of light traffic and as a foot-bridge. The work is in progress.

Dredging Cayuga Inlet.

This work is now in progress and is being done by the State dredge.

Completing Fishways on the Oswego River.

Chapter 501, Laws of 1884.

Nothing has been done to October first under this law. The evidence of their efficiency is conflicting, but it is apparent that they are liable to be clogged by eel grass, and should be regularly attended to at certain seasons of the year.

No work has yet been done under appropriations for tow-path on Beaver river or ditch at Port Byron.

Stop-Gate on Rome Level.

This division is poorly supplied with stop-gates, the only provision now made is the furnishing of timbers and plank at some of the aqueducts and bridges.

To place the timbers and plank into position requires considerable time and labor when help may not be readily obtained on

short notice. The streets of the city of Syracuse, lying as they do about twenty-five feet below the surface of the Rome level, fifty-six miles in length, with several large basins connected, would be seriously flooded if any break should occur around the railroad tunnel or through the high embankments of the towing-path side of the canal. The only place to check the flow would be at Butternut creek aqueduct, four and three-quarter miles east of the tunnel. Some form of stop-gate that could be operated readily and quickly, and at the same time make a safe and sure cut-off, should be provided for, to be located as near the west end of the level as the character of the side banks will permit. The channel should not be narrowed to less than fifty feet in width, same as at the aqueducts.

Miscellaneous.

The engineering force have assisted the Court of Claims in many important cases by making surveys, preparing maps and giving testimony. A survey of the Black river from lock No. 1 to Fish creek occupied the force between three and four weeks in the field. The map when completed represented all the interval lands for a distance of eight miles on both sides of the river, giving quantities of land and comparative levels on the same.

Measurements have been taken showing stage of water in Seneca river and Cayuga and Cross lakes, as directed by the Legislature. The following table shows results of measurements regularly taken since resolution went into effect.

SYRACUSE, *September 30, 1885.*

All of which is respectfully submitted,

DENISON RICHMOND,

Division Engineer.

STATEMENT showing the names, rank and compensation of Engineers employed upon the Middle Division of the New York State Canals, together with the Incidental Expenses, for the fiscal year ending September 30, 1885 :

ORDINARY REPAIRS.
Erie Canal.

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount..
Denison Richmond.....	Division engineer.....	Salary...	...	.....	\$2,400 00	\$1,800 00
Denison Richmond.....	Division engineer.....	Travel .....	.....	.....	.....	1,115 81
David E. Whitford.....	Assistant engineer in charge.....	Salary...	218	\$6 00	.....	1,308 00
David E. Whitford.....	Assistant engineer in charge.....	Travel .....	.....	.....	.....	78 39
David E. Whitford.....	Assistant engineer.....	Salary...	12	5 00	.....	60 00
David E. Whitford.....	Assistant engineer.....	Travel .....	.....	.....	.....	3 72
R. R. Stuart.....	Leveler	Salary...	235	4 50	.....	1,067 50
R. R. Stuart.....	Leveler	Travel .....	.....	.....	.....	118 81
Arthur V. Meeker.....	Surveyor	Salary...	4	4 50	.....	18 00
Arthur V. Meeker.....	Surveyor	Travel .....	.....	.....	.....	2 95
Charles E. Allen.....	Chainman.....	Salary...	90	2 50	.....	225 00
Charles E. Allen.....	Chainman.....	Travel .....	.....	.....	.....	20 10
<i>Incidental Expenses.</i>						\$4,308 28
Stationery.....					\$126 40	
Fuel and light.....					50 98	
Postage and telegraph.....					41 79	
Miscellaneous.....					896 20	
						625 37
Total for Erie canal.....						\$4,442 58

Oswego Canal.

Denison Richmond.....	Division engineer.....	Salary...	.....	.....	\$2,400 00	\$229 04
Denison Richmond.....	Division engineer.....	Travel .....	.....	.....	.....	16 75
David E. Whitford.....	Assistant engineer in charge.....	Salary..	6	\$6 00	.....	36 00
David E. Whitford.....	Assistant engineer in charge.....	Travel .....	.....	.....	.....	14 54
David E. Whitford.....	Assistant engineer.....	Salary...	2	5 00	.....	10 00
David E. Whitford.....	Assistant engineer.....	Travel .....	.....	.....	.....	3 58
R. R. Stuart.....	Leveler	Salary...	6	6 50	.....	27 00
R. R. Stuart.....	Leveler	Travel .....	.....	.....	.....	25 72
<i>Incidental Expenses.</i>						\$362 58
Miscellaneous						12 00
Total for Oswego canal.....						\$374 58

Cayuga and Seneca Canal.

Denison Richmond.....	Division engineer.....	Salary...	.....	.....	\$2,400 00	\$225 00
Denison Richmond.....	Division engineer.....	Travel .....	.....	.....	.....	17 46
David E. Whitford.....	Assistant engineer in charge.....	Salary...	8	\$6 00	.....	48 00
David E. Whitford.....	Assistant engineer in charge.....	Travel .....	.....	.....	.....	13 05
David E. Whitford.....	Assistant engineer.....	Salary...	3	5 00	.....	15 00
David E. Whitford.....	Assistant engineer.....	Travel .....	.....	.....	.....	6 90
R. R. Stuart.....	Leveler	Salary...	6	4 50	.....	27 00
R. R. Stuart.....	Leveler	Travel .....	.....	.....	.....	13 00
Charles E. Allen.....	Chainman	Salary...	2	2 50	.....	5 00
Charles E. Allen.....	Chainman	Travel .....	.....	.....	.....	3 20
Total for Cayuga and Seneca canal.....						\$373 71

Black River Canal.

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond	Division engineer.....	Salary...	...	.....	\$2,400 00	\$376 37
Denison Richmond	Division engineer.....	Travel ..	...	.....	.....	86 37
David E. Whitford	Assistant engineer in charge.....	Salary...	40	\$6 00	.....	240 00
David E. Whitford	Assistant engineer in charge.....	Travel ..	...	.....	.....	28 98
R. R. Stuart.....	Leveler.....	Salary...	20	4 50	.....	90 30
R. R. Stuart.....	Leveler.....	Travel ..	...	.....	.....	52 00
Arthur V. Meeker.....	Surveyor	Salary...	41	4 50	.....	186 00
Arthur V. Meeker.....	Surveyor	Travel ..	...	.....	.....	38 68
Dennis Vaughan.....	Chainman	Salary...	24	2 50	.....	60 00
Dennis Vaughan.....	Chainman	Travel ..	...	.....	.....	31 21
John Sayres	Axman	Salary...	18	2 50	.....	45 00
<i>Incidental expenses.</i>						\$1,250 61
Miscellaneous						15 50
Total for Black River canal.....						\$1,266 11

*SUMMARY of Engineering expenses upon Ordinary Repairs
of the Middle Division New York State Canals, for the fiscal
year ending September 30, 1885:*

Erie canal.....	\$6,948 05
Oswego canal	374 58
Cayuga and Seneca canal.....	373 71
Black River canal	1,266 11
Total for ordinary repairs	<u>\$6,948 05</u>

EXTRAORDINARY REPAIRS.*Black River Canal.*

[Making survey for a dam on the Beaver river. Act chapter 551,
Laws of 1884.]

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond	Division engineer.....	Salary...	...	.....	\$2,400 00	\$52 60
Denison Richmond	Division engineer.....	Travel ..	...	.....	.....	84 88
R. R. Stuart.....	Leveler	Salary...	7	\$4 50	.....	31 50
R. R. Stuart.....	Leveler	Travel ..	...	.....	.....	9 04
F. N. Kimball.....	Chainman	Salary...	59	2 50	.....	147 50
James Shanahan, Jr.....	Axman	Salary...	52	2 50	.....	130 00
<i>Incidental Expenses.</i>						\$455 53
Miscellaneous.....						8 50
Total for Beaver river dam						\$464 02

EXTRAORDINARY REPAIRS—(Continued).

Black River Canal.

[Dam above Forestport pond. Act chapter 452, Laws of 1883.]

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond.....	Division engineer.....	Salary...	....	....	\$2,400 00	\$32 88
Denison Richmond.....	Division engineer.....	Travel..	....	....	.....	12 59
David E. Whitford.....	Assistant engineer in charge.....	Salary...	7	\$6 00	.....	42 00
David E. Whitford.....	Assistant engineer in charge.....	Travel..	....	....	.....	9 68
David E. Whitford.....	Assistant engineer.....	Salary...	8	5 00	.....	40 00
David E. Whitford.....	Assistant engineer.....	Travel..	....	....	.....	16 68
Total						\$153 88

Erie Canal.

[Furnishing and placing an iron pipe sewer under the Erie canal at the "Gulf," near Broad street bridge, Utica. Act chapter 119, Laws of 1885.]

NAMES.	Rank.	Salary or Travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond... ..	Division engineer.....	Salary...	....	....	\$2,400 00	\$118 36
Denison Richmond... ..	Division engineer.....	Travel..	....	....	.....	34 88
David E. Whitford.....	Assistant engineer in charge.....	Salary...	4	\$6 00	.....	24 00
David E. Whitford.....	Assistant engineer in charge.....	Travel..	....	....	.....	5 06
R. R. Stuart.. ..	Leveler.....	Salary...	16	4 50	.....	72 00
R. R. Stuart.....	Leveler.....	Travel..	....	....	.....	35 72
Total						\$290 01

[Lengthening lock No. 50. Act chapter 80, Laws of 1884.]

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond.....	Division engineer.. ..	Salary...	...	....	\$2,400 00	\$65 75
Denison Richmond.....	Division engineer.....	Travel..	....	....	.....	2 50
David E. Whitford.....	Assistant engineer in charge.....	Salary...	3	\$6 00	.....	18 00
David E. Whitford.....	Assistant engineer in charge.....	Travel..	....	....	.....	80
David E. Whitford.....	Assistant engineer.....	Salary...	2	5 00	.....	10 00
R. R. Stuart.....	Leveler.....	Salary...	7	4 50	.....	31 50
R. R. Stuart.....	Leveler.....	Travel..	....	....	.....	1 20
Charles E. Allen.....	Chainman.....	Salary...	102	2 50	.....	255 00
Charles E. Allen.....	Chainman.....	Travel..	....	....	.....	18 40
Incidental Expenses.						\$398 15
Miscellaneous						146 00
Total						\$544 15

*SUMMARY of Engineering Expenses upon the Middle Division
of the New York State Canals, for the fiscal year ending Sep-
tember 30, 1885 :*

Ordinary repairs.....	\$6,948 06
Extraordinary repairs:	
Beaver river dam.....	464 02
Forestport dam.....	153 83
Pipe sewer at the gulf, Utica	290 01
Lengthening Lock No. 50	544 15
	<hr/>
Total engineering expenses for Middle Division...	<u>\$8,400 06</u>

WESTERN DIVISION.

ANNUAL REPORT OF THOMAS EVERSHED, DIVISION ENGINEER, FOR THE
FISCAL YEAR ENDING SEPTEMBER, 30, 1885.

ROCHESTER, N. Y., *October 1, 1885.*

HON. ELNATHAN SWEET, *State Engineer and Surveyor:*

SIR. — In compliance with the requirements of act chapter 169, Laws of 1862, in relation to the engineer department, I have the honor of presenting to you my report on the Western Division of the State canals, for the fiscal year ending on the 30th day of September 1885.

This division now comprises that portion of the Erie canal from Buffalo to the point where the canal crosses the southern boundary of Wayne county, which, together with the slips and feeders, comprises a distance of 153.18 miles, as follows:

	Miles.
Erie canal, south line of Wayne county, to Hamburg street Buffalo.....	148.92
Five slips in the city of Buffalo:.....	1.60
Genesee river feeder in Rochester.....	2.25
To which may be added the terminal basin of the Genesee Valley canal.....	.41
Total.....	153.18

It was divided for convenience of repairs into four sections:

	Distance in miles.
Section 8 begins on the south line of Wayne county, ends east line of Monroe county.....	35.924
Section 9 begins east line of Monroe county, and ends at end of construction section 284, Brockport.....	39.624
Section 10 begins at end of construction section 281, ends at upper end of Sulphur Spring guard-lock.....	46.560
Section 11 begins at upper end of Sulphur Spring guard-lock and ends at Buffalo.....	26.815
Total length.....	148.923

The Erie canal on this division receives its principal supply of water from Lake Erie, supplemented at times by the Tonawanda

creek at Pendleton, Tonawanda and Oak Orchard creeks feeder at Medina, and the Genesee river feeder at Rochester.

The Lake Erie water comes into the canal through the different slips in the city of Buffalo.

After passing a guard-lock situated at Black Rock, it passes through a canal on the east bank of the Niagara river for a distance of twelve miles to the village of Tonawanda, where it enters a creek of that name, and in the ordinary stage of water it reverses the flow of that stream for a distance of twelve miles, when at the village of Pendleton it enters the "Deep Cut," so-called, and for a distance of seven miles runs through deep earth and rock cutting to the city of Lockport, where it descends the face of the mountain ridge by five combined locks to what is known as the "Long Level," between that place and the city of Rochester, passing through a country whose slope is to the northward or toward Lake Ontario.

At a distance of eighteen miles east of Lockport at Medina the Tonawanda and Oak Orchard creeks feeder empties into the canal, affording an abundant supply in the spring, when it assists materially in filling the canal; during the summer months, however, the supply from this source is quite small.

At Rochester it receives in like manner a plentiful supply from the Genesee river for filling the canal. At other times the supply is cut off, with the exception of that from Allen's creek, an affluent of the Genesee river. The supply from this source is brought down the old Genesee Valley canal (now disused as such) to the southern bounds of the city, at which point it is carried under the river and emptied into the Genesee river feeder, from whence it flows into the canal.

The source of supply for this division may, therefore, be said to be Lake Erie, except during the filling in the spring, when it is supplemented by the Tonawanda and Oak Orchard creeks feeder and the Genesee river as before mentioned.

The latter stream can, however, in case of necessity be made to furnish a much larger supply at any time by putting flush-boards on the dam at the head of the feeder. This is sometimes done when the growth of eel-grass on the long level between Rochester and Lockport is such as to hinder the flow of water, and the supply from the west is found to be insufficient to supply navigation as far east as the Montezuma level.

To make up for the water thus taken for the canal, that in the river is supplemented by that from a reservoir formerly used to supply the summit level of the Genesee Valley canal.

This reservoir is situated on Oil creek just north of the village of Cuba. Its area is about 600 acres. When full it will supply about 4,000 cubic feet per minute for the three driest months in the year. The dam which holds back this amount of water is 2,200 feet in length, and is sixty-five feet in height where it crosses the original creek bottom.

At a point about two miles from this dam is a smaller one, on which is situated a waste-weir, over which the water flows when the reservoir is full. The whole is in good condition.

The consumption of water for navigation purposes has been of late years very much reduced, by following the suggestions made by me as detailed in my report of 1879, since which time no trouble may be said to have been experienced on the eastern levels by delays to the boatmen in consequence of low water.

The growth of eel-grass, usually so troublesome by holding back the water on the long level, has not been so great this year as usual, consequently an abundant supply has been had throughout the division.

Dams.

There are three dams on this division, besides the two earthen ones at the reservoir before described.

First. That across the mouth of the Tonawanda creek; it is 112 feet in length. At the north end thereof is a bulk-head containing twelve gates four by five feet each. These are raised in case of a flood in the creek.

This dam raises the water about four feet, dependent on the height of the water in the river. The dam and bulk-head are both in excellent condition.

Second. The dam across the Tonawanda creek, located south of Medina. It is of the same construction as that near its mouth, viz.: timber, brush, stone and gravel. It raises the water about three feet, sufficient to throw the current through the feeder before mentioned as emptying into the canal at Medina.

Third. The Genessee river feeder dam situated just south of the city of Rochester. It is 510 feet in length. It raises the water in the river about three feet, sufficiently high to turn the river water into the feeder through the bulk-head, which is situated on the east bank of the river.

This dam has in its center eight wooden piers, between which the water is allowed to flow when the dam is not in use for supplying the canal. When it is used for this purpose these spaces are filled in a temporary manner, the object of this crude method being to allow the water, when not needed for feeder purposes, to flow in a manner nearly as though no dam existed.

Four of these piers are very much decayed and should be renewed; the planking on the dam proper should be also renewed. The embankment on the west end should be raised and strengthened and the front rip-rapped. The masonry of the abutments and bulk-head requires pointing up. The estimated cost of these repairs is \$3,000.

Locks.

There are twenty-three locks on this division, besides the weighlocks at Rochester.

Fourteen double lift-locks, 110 by 18 feet in the chamber, with lifts as follows:

No. of lock.	Location.	Lift, in ft.
53.	One and a quarter miles west of Clyde.....	4.755
54.	At Lock Berlin.....	7.360
55.	In the village of Lyons.....	6.251
56.	"Poor-house," one and one-tenth miles west of Lyons.	9.848
57.	In village of Newark.....	8.028
58.	In village of Newark.....	8.004
59.	In village of Newark.....	8.002
60.	Eight-tenths of a mile east of Macedon.....	9.886
61.	In the village of Macedon.....	6.601
62.	Two and a quarter miles west of Pittsford.....	8.807
63.	"Miller's," in village of Brighton.....	8.719
64.	"Sipple's," in village of Brighton.....	10.108
65.	"Reservoir," in city of Rochester.....	10.102
66.	"First lock," in city of Rochester.....	8.859
67 to 71.	Five double combined locks at Lockport....	57.427
One guard-lock at Sulphur Spring. Five and a quarter miles above Lockport, it has a chamber 110 by 20 feet, with two additional head-gates, similar in character to lock-gates, one of which, as well as the lock itself, stands open during the season of navigation, unless it be in times of flood in Tonawanda creek, when they are closed and the lock in use as such; one "river lock" at Tonawanda village — a lift-lock (single) — connecting the Niagara river with the canal, the rise being generally about four feet; one double-chambered guard-lock at the foot of the harbor at Black Rock, 112 by 20 feet. The lift, together with the fall in the harbor, is generally about two and a half feet, varying with the water in the lake. Taking low water, as per United States engineer record, it is.....		2.425

Making the total lift on the division..... 175.182

By adding to the above-mentioned lift by locks the surface descent on the different levels, we get the total rise on the division.

	Lift, in ft.
On the Montezuma level west of the Richmond aqueduct,	0.196
On the "Twelve-mile" level between locks Nos. 59 and 60,	0.165
On the "Seventeen-mile" level between locks Nos. 61 and 62,	0.343
On the "Three-mile" level between locks Nos. 62 and 63,	0.063
On the "Long Level" between Rochester and Lockport, locks Nos. 66 and 67.....	3.165
On the level between Lockport lock 71 and Black Rock guard-lock.....	1.239
Total rise going west.....	180.353

Besides the above locks, there is a ship-lock between the water in Black Rock harbor and the Niagara river at Black Rock, it is 200 feet by 36 feet, it usually has a lift of about four feet, varying with the height of the water in the river.

There is also a weigh-lock in the city of Rochester, not now in use, since the necessity of weighing boats is done away with by reason of the "free canals." It should be kept in order, as it is a very useful harbor of refuge for leaking or sinking boats.

It is in good condition, except the west drop gate, which requires renewal.

Repairs to Locks.

The following repairs were made last spring:

To foundations locks Nos. 54, 56, 60, 67, 68, 69, 70 and 71.

One pair swing gates were renewed in locks Nos. 54, 57, 58, and two pair in the guard-lock.

Black Rock, and one tumble-gate in locks Nos. 53, 54, 56 and 58.

One mitre-sill was inserted in lock No. 56.

Eighteen new balance-beams were put on, and thirty-four new paddle inserted on sections 8 and 9.

Three new cast-iron valves were inserted in the masonry of the Lockport locks.

Several of the locks were pointed up.

The south wall of the north lock 60 was thoroughly grouted.

The following repairs are necessary:

One pair swing-gates in locks 54, 58 and 65. Two pair in lock 62, and several pair in the Lockport locks.

Two tumble-gates in lock 56, and one in lock 65.

One new mitre-sill in each lock Nos. 64, 65 and 66.

Thirty new paddles in the different lock-gates on sections 8 and 9.

New piers at the head and foot of lock No. 61.

The foundations of locks Nos. 53, 54, 59, 60, 61, 66, 67, 68, 69, 70 and 71 require to be renewed wholly or in part.

Several of the locks require to be pointed on section 8, as well as the guard-lock at Sulphur Spring, and the ship-lock at Black Rock. The coping on the last-named lock has been driven back by striking of the heavy vessels which pass through it. It requires to be taken up and relaid. Other repairs are at the same time required to the masonry throughout the structure.

The south wall of the upper lock at Lockport has been sprung in by the action of the frost; the hollow quoin should be trimmed back so as to allow of the gate being removed out of the way of the boats.

Aqueducts.

There are four aqueducts on the division viz.; one each at Lyons and Palmyra both of which have wooden trunks, and one each at Rochester and Medina, both of which are wholly of stone.

[Assembly, No. 44.]

The one at Lyons is in good order, with the exception of pointing the masonry.

In that at Palmyra the floor timbers are very much decayed, and should, with but few exceptions, be renewed. The masonry of this structure should also be pointed up. At the west end, on the berme side of the canal, there should be a piece of twisted wall constructed, to make the embankment secure, as recommended in my report of 1883. for the want of which, it is presumable, a break occurred on the east end in June 1884.

Of the Rochester aqueduct, I beg to repeat what I said in my former reports, viz., that the bottom should be coated over with cement, mortar, or asphalt, to replace one of tar, put in some years ago, and which has long since gone to decay. The bottom of this aqueduct was lowered, and the original plank bottom removed, very much to the detriment of this fine structure. The water filtering through the seams and joints of the arch stone will, in a very few years, entirely destroy its usefulness, in this very severe climate, by freezing and splitting the stone composing it. Estimated cost, \$3,000.

The same remark will apply to the Médina aqueduct, where the earth should be removed from behind the parapet walls and the trunk, when the masonry should be thoroughly grouted up and pointed, and the earth replaced, and, at the same time, thoroughly tamped and puddled. Estimated cost, \$750.

I would earnestly recommend that both the last mentioned structures be attended to at once.

Waste-Weirs.

There are twenty-four on the division; they have been carefully made to agree with and regulate the surface of the water on the different levels.

The following repairs are needed: The one at the foot of Clyde lock, those at Lyons, Medina, Middleport and Lockport should have the timber work renewed.

Those at Brockport, Albion and Brockville should have the masonry repaired, and on almost all of them the stone work should be pointed up.

The waste-gates of the one at Eagle Harbor were carried away in 1873. Last spring what remained of this structure, viz., about forty feet of the weir, was carelessly undermined and had to be removed and a bank substituted. The whole should be renewed, as the distance between the waste-weirs on either side is too great for the safety of the canal.

Bridges.

There are 219 bridges over the Erie canal, slips in Buffalo and elsewhere belonging to the State, and three which belong to the city of Rochester, the latter are lift bridges, and are located at Allen, Brown and Lyell streets.

Of those belonging to the State, 209 are of single span, one has two spans, four have three spans, three are swing bridges, and two are wooden draw bridges over slips in Buffalo.

There are also three wooden truss-bridges over the State ditch in South Tonawanda, five of iron over State ditches in or near the same village, one iron road bridge over the Tonawanda and Oak Orchard feeder at the Batavia road, one iron road-bridge over the old canal at Pendleton, one over road-bridge over old canal at Knappville, and one over State ditch near Sulphur Spring guard-lock.

There are also fifty-two wooden road-bridges over State ditches in Niagara and Erie counties.

An iron bridge was erected over the Erie canal last spring at Prospect street, Medina; it was paid for by special appropriation of the Legislature.

One was erected at Gasport in place of a decayed wooden structure, No. 151, at the same time.

One has been prepared and is delivered on the spot to take the place of a temporary wooden one at Louisiana street in the city of Buffalo, over the Hamburg canal; it will be erected at once.

An appropriation having been made last winter for an iron structure over the canal at Pinnacle avenue in the city of Rochester, plans have been perfected and it will be built before the opening of navigation next spring.

The following wooden bridges have been renewed during the fiscal year: Nos. 28, 44, 51, 124, 132, 134, 136, 149 and span C of 166. Also the draw towing-path bridge over the mouth of Scajquada creek, No. 193.

An iron bridge (formerly a portion of the Ischua aqueduct) was constructed over the State ditch near Sulphur Spring, taking the place of a much decayed wooden structure.

The iron bridge at Hamilton street, in the city of Buffalo, has been raised so as to be out of the way of light boats.

All the bridges have received the ordinary repairs that were needed. On the swing-bridge at Exchange street, Rochester, new rollers have been introduced. That at West avenue has had extensive repairs made to the crib work.

The following wooden bridges will have to be renewed during the next year: Nos. 57, 162, 163, 144, 173, two spans; Nos. 162 and 163, being over the rock cutting in the city of Lockport, should be constructed of iron.

A much decayed wooden bridge over the State ditch in the village of North Tonawanda should be replaced by a double arch culvert of ten feet spans, after which no further expense would be incurred for many years.

Masonry of Bridges.

The stone for abutments are on the ground to take the place of bents which now support bridge No. 45 in the village of Fairport. Estimated cost, \$400.

The masonry of the Culver road-bridge, No. 62, has never been completed. The embankments are quite narrow and dangerous in consequence; it should be finished. Estimated cost, \$450.

New abutments of stone should be constructed at the Scajaquada creek towing-path bridge. The stone are on the spot. Estimated cost, including pile foundation, \$800.

The towing-path abutment at Pickard's bridge, No. 174, was rebuilt last spring with rubble masonry, the stone for which were procured at the Black Rock quarry. The berme abutment will also be built this fall; both will then have substantial pile foundations.

The masonry of the south abutment of the towing-path bridge over the Tonawanda creek at Pendleton will have to be rebuilt at once or otherwise secured. I would advise tying it back with rods of iron as a temporary measure, as the superstructure will have to be renewed very shortly, when the masonry can be rebuilt to suit the new bridge.

The masonry of one of the abutments of the bridge over the slip leading to the river lock in Tonawanda has also to be rebuilt. It should be taken down and relaid next winter, and the foundation re-enforced with additional piles.

A new abutment was built last spring on the berme side of the canal at Cartersville by the railroad company, whose bridge it is, in such a manner as to improve the water-way very much, which at this point was both narrow and crooked.

Nearly all the abutments on this division require repairs. On many of them stone are wanting which should be replaced, and the whole needs pointing.

Piles should also be driven to protect some of them from being damaged by boats under the action of heavy winds.

Culverts.

There are 136 culverts on the division. No. 36 on the three-mile level is of wood. Exposed to the action of the atmosphere the whole length, it has become much decayed and should be rebuilt in stone next spring. Estimated cost, \$4,700.

The culvert leading from the back ditch to the canal on the mountain ridge at Murphy's farm, west of Lockport, requires repairs. Estimated cost, \$450.

A small culvert under the Genesee river feeder has given way; it should be replaced by a wooden box. Estimated cost, \$350.

The masonry on all the culverts on the division requires more or less repairs. In many the wings and parapets have been thrust forward by the frost; they should be replaced, and should be filled in behind with broken or field stone as a protection against the action of the frost in the future.

Estimated cost of such repairs, \$6,000.

Stop-Gates.

There are six stop-gates on this division, viz.: On each side of the Irondequoit embankments on the Seventeen-mile level; one at Adam's basin; one on each side of the heavy embankment at Holley, and one a short distance east of Medina.

The wood-work of those at Bushnell's basin, Cartersville and Adams' basin should be renewed shortly, as they are quite old.

The masonry on the most of these structures requires pointing up, and otherwise repaired.

Vertical Walls.

The vertical walls on the division are very much out of order, and should have a great deal of labor laid out on them to place them in proper condition.

Considerable repairs have been made and new docking placed in the city of Buffalo during the last year, thus securing that portion for some time to come.

About eighty feet in length was built at Macedon, near the foot of lock 61.

Seventy feet in length was taken down and relaid at the foot of the Clyde lock, and about thirty feet east of the aqueduct, at Palmyra.

The work of replacing the slope wall below the Lyons lock with vertical wall was continued last spring; about eighty feet still requires to be done to complete the improvement on the bend below the lock.

A piece of vertical wall on Commercial slip in Buffalo has slipped into the canal and should be replaced in a permanent manner with pile foundation.

At several places in the city of Buffalo and Black Rock harbor walls have fallen into the canal, the debris have been removed with the dredge, a permanent foundation of piles formed, and the wall above water replaced, notably on the north side of the west abutment of Hamilton street bridge, where the heavy retaining wall fell in for fifty feet in length.

Slope Walls.

The slope walls on the long level west of Rochester are very much out of shape, owing to the action of the frost on the peculiar soil of that region, which is a mixture of clay and quicksand.

Canal Banks.

On each of the sections attention has been paid during the past season, with the means at hand, to raising the banks where they were low; this was particularly so on the Montezuma level, where the berme bank has been raised to a height of two feet above the water for a part of its length. When this work is completed on the whole level, portions of which are completed in both the Mid-

dle and Western Divisions, it will allow the water to be raised and facilitate navigation thereby.

Towing-Path.

Improvement has been made during the past fiscal year on the different sections by graveling the towing-path ; much still remains to be done.

On Tonawanda creek, from the towing-path bridge over the Eighteen-mile creek, eastward, for a distance of 1,370 feet, the docking has been repaired in a thorough manner by driving piles in front of the old docking and capping the same with oak timber.

East of this the old and decayed docking has for a distance of nearly two miles been entirely removed and the front of the towing-path rip-rapped as recommended in my report of 1881.

On a good portion of the rest of the creek the old docking has been removed where it occurred and the face of the towing-path rip-rapped in like manner, the towing-path raised to a proper height and covered with gravel or cinders, the latter being, from its binding qualities, an excellent substitute for gravel.

Protection of the towing-path in the city of Buffalo from the encroachments of Lake Erie has long been needed. Last winter the Legislature made an appropriation for this purpose; it has been expended in the construction of a sea wall for a distance of 1,080 feet in length, immediately in the rear of the towing-path, raising the towing-path itself and the vertical wall in front of it four and a half feet, and paving the former so as to prevent damage to it from whatever water may be dashed over the sea wall during heavy storms.

The Prism of the Canal.

About the usual amount of work was done last spring in removing the accumulations in the bed of the canal.

This annual "cleaning out the canal" does not, on this division, keep pace with the increase of matter deposited.

Other means should be resorted to ; that adopted by the Illinois canal authorities would seem to be the best, viz., steam dredge to remove the silty matter and place in boxes on boats, and a steam derrick to dump the boxes, as set forth in my report of 1880.

The harbor, slips and canal in Buffalo still require the constant work that can be done by one dredge. It would, therefore, be necessary to have another if this system is to be resorted to.

Bird Island Pier.

No work of consequence has been done on this structure during this season. The foreshore in front of the wooden portion of the upper end should be completed as a protection against the storms of Lake Erie.

On that portion reaching down the river from a point opposite the railroad bridge, a good deal of work should be done to restore it on the river side where it is a good deal torn to pieces by the action of the ice.

Erie Breakwater.

No work has been done on this breakwater this year; considerable should be done to this important structure to keep it in good repair.

Navigation of 1885.

The navigation of this portion of the canal has been thoroughly good during the season, no detentions having occurred with the exception of about twenty-four hours on October 29, 1884, when a small break occurred on the Three-mile level east of Rochester. Several serious leaks have occurred, however, which were quickly stopped by early attention on the part of the section superintendents.

Borrow Pits.

The new borrow-pits have been laid out during the year last past for procuring material for graveling and raising banks. There should be several more at various points, and several of the old ones, the material in which is now very far away from the canal, could be improved by dredging a channel up to the face of the bank, and thereby facilitate the loading of boats.

Buffalo Trunk Sewer.

This important work is now fast approaching completion. The sewer proper may be said to be finished. The contractor for the outlet portion is now engaged in the last coffer-dam, on the construction of the heavy wall of cut stone which will form the extreme river end of the sewer, and which in alignment corresponds with the Bird Island pier and which will be connected therewith.

This sewer will have a connection with the Hamburg canal at its extreme upper end, at which point a constant flow will be maintained from the Hamburg into the sewer, which will, it is to be hoped, entirely relieve the former from its impurities, and that when the connection is made from the Bird avenue sewer into the trunk sewer at Albany street, it will divert the whole flow of the sewage of Buffalo into Niagara river at the latter point with the exception of that portion between the canal and the harbor of Buffalo, a large portion of which should be gathered together and be pumped across the canal into this sewer.

I have in this report endeavored to point out all the things which ought to be done to restore, in a measure, the canal to a good state of repair, which, as is easy to be seen, would require much larger expenditure for labor and the purchase of materials than the money will allow which is placed yearly at the command of the Superintendent of Public Works by the Legislature.

I deem it to be an extremely unwise policy, which so restricts him in this respect, that he cannot restore the ravages which time and the elements inflict on this water-way, so important to the well-being of the State at large.

I have had the honor, under your directions, of completing during the last fiscal year, both the drainage of the buildings of the State Asylum for the Insane at Buffalo, and the sewer from said buildings from Forest to Bird avenues, which was left incomplete in consequence of a change in the law governing it being required. Both these improvements answer thoroughly the purposes for which they were intended.

This division has been under the charge of Thomas Evershed as division engineer and of John Bisgood as resident engineer during the past fiscal year.

I have the honor to be

Your obedient servant,

THOMAS EVERSHED,

Division Engineer.

STATEMENT giving names, rank, number of days and compensation of engineers upon the repairs of the Western Division of the New York State canals, with incidental expenses, during the fiscal year ending September 30, 1885.

(Act Chapter 169, Laws of 1863.)

ERIE CANAL.

Repairs from October 1, 1884, to September 30, 1885.

	Amount.	Total.
Thomas Evershed, division engineer, 9-12 of a year, salary \$2,400.....	\$1,800 90	
Thomas Evershed, division engineer, expenses	228 64	
John Bisgood, resident engineer, 11-12 of a year, salary \$2,000.....	1,833 33	
John Bisgood, resident engineer, expenses.....	176 67	
John Bisgood, assistant engineer, 27 days at \$5 per day	135 00	
George P. Hilton, draughtsman, Prospect and Louisiana street bridges, and Sacjagada creek bridge.....	88 00	
Milton W. Wilbur, chainman, 27 days at \$2.50 per day	67 50	
Milton W. Wilbur, rodman, 286 days at \$3.50 per day	1,001 00	
Milton W. Wilbur, rodman, expenses	152 99	
Joseph B. Barrett, chainman, 234 days at \$2.50 per day	585 00	
Joseph B. Barrett, chainman, expenses....	59 33	
		<hr/> \$6,127 46

Stationery.....	\$88 84	
Fuel, light and office rent	403 60	
Postage and telegraph.....	52 40	
Miscellaneous.....	166 10	
		<u>\$710 94</u>
Total for ordinary repairs.....	\$6,838 40	

The following amount of work and travel has been done by the engineering force on this division, outside of their regular duties on ordinary repairs, during the fiscal year.

Draining Basement of the Asylum Buildings, Buffalo, N. Y.

(Act Chapter 488, Laws of 1884.)

	Amount.	Total.
Thomas Evershed, division engineer, 3-12 of a year, salary \$2,400.....	\$600, 00	
Thomas Evershed, division engineer, expenses	68 49	
R. R. Stuart, assistant engineer, 16 days at \$5 per day	80 00	
R. R. Stuart, assistant engineer, expenses..	50 44	
A. P. Courter, expenses, 106 days at \$5 per day	530 00	
Joseph B. Barrett, chainman, 49 days at \$2.50 per day.....	122 50	
Joseph B. Barrett, chainman, expenses....	9 72	
		<u>\$1,461 15</u>

Sewer to Insane Asylum, Buffalo, N. Y.

(Act Chapter 151, Laws of 1884.)

A. P. Courter, inspector, 91 days at \$5 per day	455 00
Grand total.....	<u>\$1,916 15</u>

ANNUAL REPORT, HUDSON RIVER IMPROVEMENT, 1885. }
ALBANY, December , 1885. }

HON. ELNATHAN SWEET, *State Engineer and Surveyor* :

SIR.—I have the honor to transmit, herewith, my annual report of the Hudson river improvement for the current year.

CHAS. G. WITBECK,

Assistant Engineer in charge of the Hudson River Improvement.

The deep water of the Hudson river extends from Governor's Island to about midway between Stuyvesant and New Baltimore, from which point northerly to the State dam at Troy, the water is

comparatively shallow, and navigation has always been attended with more or less difficulty on this part of the river. The problem of improving this portion of the Hudson river, by reason of its tortuous course, extreme breadth and the peculiar action of its tides and heavy freshets, is one that has called forth the best energies of both National and State engineers of the present century, the importance of this water-way being conceded by all as being of vital character, as it is the outlet of the entire canal system of the State of New York, which has in the past carried the greater portion of the product, not only of this State but adjoining country, and in the future will always be an important factor to the welfare of this State.

The first record of any permanent improvement contemplated was in 1797, when the depth of water between the above-named points was only four feet at mean low tide, which stage of water continued until about 1819. From 1797 to 1833 the amount of \$225,707.25 was expended by the State authorities, for which an increased depth of three and one-half feet was secured, making a total depth, at this period, of seven and one-half feet at mean low tide. From 1834 to 1863, \$400,000 was expended in improvement of the channel and in constructing dikes and jetties by the general government. From 1863 to 1885, \$920,188 was expended by the general government, and \$920,210 was expended by the State authorities, and a depth of ten feet between Albany and Cocksackie and eight feet between Albany and Troy was secured at mean low tide.

The plan of improvement of the Hudson river found to be the most feasible and which has shown the most practical results is:

First. A system of longitudinal dikes and jetties to confine the flow and storage of the tidal currents.

Second. Dredging shoals that necessarily form at angles in the river and dikes, which produce ice gorges and slack water, by which silt and light materials are deposited. By these means a mean depth of water at all points is maintained. But to secure this mean depth of water at all points annual appropriation continues to be necessary. All material dredged should be placed behind dikes in such a manner as to prevent it moving back in the channel. Making a uniform channel 200 feet in width and from ten to twelve feet in depth at mean low tide from the Troy railroad bridge to Cocksackie is made necessary by the increased draft of vessels used in present navigation.

STATEMENT showing greatest depth at mean low-water at various points on the Hudson River for a series of years.

	Survey of United States Engineers.										Survey of State Engineers.			
	U. S. Coast Sur- vey chart.	Survey of Hon. W. J. McAl- pin.	U. S. Coast Sur- vey.	1867.	1869.	1872.	1875.	1876.	1877.	1878.	1882.	1884.	1885.	
Washington bar.....	...	...	...	8.0	...	7.5	...	7.5	8.0	9.0	...	...	8.2
Van Buren bar.....	...	...	...	8.0	...	...	...	7.0	7.0	7.8	...	7.1	6.1
Covills folly.....	...	...	...	7.0	...	7.1	...	7.0	7.4	8.3	...	...	8.1
Round shoals.....	...	...	...	7.2	...	6.5	7.1	7.0	7.0	7.5	6.9	6.8	6.5
Fish-House shoals.....	...	...	...	7.4	...	7.4	7.4	7.0	7.7	7.5	...	6.7	5.2
Cuyler bar.....	4.0	7.5	7.5	8.5	...	8.5	8.5	...	8.8	9.5	...	...	8.8
Overslough bar.....	5.0	8.7	9.0	7.7	...	8.5	...	8.0	8.8	9.8	7.9	6.5	9.8	
Cedar Hill bar.....	...	...	...	7.6	8.5	8.6	...	9.5	10.5	10.5	...	...	9.8
Van Wie's bar.....	...	8.5	...	8.5	...	10.0	10.0	...	10.2	...	8.3	...	8.8	
Castleton bar.....	10.0	6.5	7.5	8.0	...	9.0	...	...	10.0	10.0	...	...	10.0
Nine-mile tree bar.....	...	8.1	...	8.5	...	8.7	...	10.5	10.5	10.5	...	...	10.0
Mulls bar.....	...	...	...	9.0	...	8.2	...	8.5	9.0	9.4	7.5	9.8	9.9
Coeymans bar.....	5.0	...	...	8.5	7.2	8.7	8.3	8.5	8.5	9.3	...	...	10.0
New Baltimore bar.....	...	...	...	8.0	8.5	9.0	8.0	7.7	8.5	9.0	8.7	10.0	9.8

TABLE showing expenditures by the State and United States on the Hudson River from 1797 to 1885.

Amount appropriated by State.		Amount appropriated by United States.	
1797 to 1863...	\$225,707 21	1834 to 1863...	\$400,000 00
1863.....	100,000 00	1864 to 1866...	50,000 00
1865.....	125,000 00	1867.....	305,188 00
1866.....	150,000 00	1868.....	85,000 00
1867.....	150,000 00	1869.....	90,000 00
1872.....	50,000 00	1870.....	40,000 00
1873.....	50,000 00	1871.....	40,000 00
1876.....	40,000 00	1872.....	40,000 00
1877.....	15,000 00	1873.....	40,000 00
1878.....	30,000 00	1874.....	40,000 00
1879.....	30,000 00	1875.....	40,000 00
1880.....	30,000 00	1876.....	50,000 00
1881.....	30,000 00	1877.....	70,000 00
1882.....	30,000 00	1878.....	30,000 00
1883.....	30,000 00	1879, Van Wie's	
1884.....	30,000 00	rock.....	30,000 00
1885.....	30,000 00		
	<u>\$1,145,917 21</u>		<u>\$1,350,188 00</u>

As will be seen by the above table, no appropriations have been made by the United States Government since 1879, from which date the whole burden of improvement of the Hudson river, its channel and dykes has been carried on by the State and, unless some provision is shortly made for the repair of existing dykes and jetties, of which some are sadly in need of repairs, and new ones are needed in other places, much larger yearly appropriations will soon be necessary.

The surveys made this season by the engineering corps have been as follows, viz.:

1. Van Wie's (ice gorge).
2. Reconnaissance of channel below New Baltimore and Troy railroad bridge.
3. Bath.
4. Fish House
5. Kellogg.
6. Break in Castleton dyke.
7. Van Buren bar.
8. Upper side-cut (Troy).
9. Extension of New Baltimore.
10. Onyler bar.
11. Fish House (final).
12. Bath (final).
13. Parda Hook.

14. Mull's:
15. Catskill creek (special supply bill).
16. Esopus creek (Saugerties).
17. Railroad bridge, Troy to State dam.
18. Location of exterior dock line, Hillhouse Island, for which I would refer you to maps now on file in your office.

The following table shows the result of work done and contracts let by the Superintendent of Public Works and also statements of disbursements of the engineering department of the Hudson river improvement for this year.

STATEMENT of Disbursements by the Engineering Department of the Hudson River Improvement for the year 1885.

MONTH.	Salaries of corps.	Travel and hotel expenses.	Office expenses.	Labor and material.	Wages of boatmen.	Use of sounding boats.	Tug hire.	Total.
April.....	\$95 00	\$3 55	...	\$1 50	\$8 00	\$4 00	\$26 25	\$138 30
May ..	305 50	4 75	\$23 25	1 43	36 00	14 00	51 25	436 18
June	403 00	35 69	20 65	1 91	40 00	16 00	.....	517 25
July.....	418 50	59 80	1 41	8 28	30 80	14 00	.....	532 79
August.....	403 00	50 02	.....	10	7 00	.....	.....	460 12
September.....	403 00	47 11	1 00	1 71	15 00	6 75	.....	474 57
October.....	418 50	17 62	60	.....	.....	.....	.....	436 72
November.....	387 50	8 10	1 50	.....	.....	.....	.....	397 10
December.....	418 50	.....	6 75	.....	.....	.....	.....	425 25
	\$3,252 50	\$226 64	\$56 26	\$14 93	\$136 80	\$54 75	\$77 50	\$3,318 28

ANNUAL REPORT

OF THE

State Engineer and Surveyor

ON THE

CANALS OF NEW YORK,

FOR THE

Fiscal Year Ending September 30, 1886.

TRANSMITTED TO THE LEGISLATURE JAN. 20, 1887.

ALBANY:
THE ARGUS COMPANY, PRINTERS.
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STATE OF NEW YORK.

No. 38.

IN ASSEMBLY,

JANUARY 20, 1887.

ANNUAL REPORT.

OF THE

STATE ENGINEER AND SURVEYOR.

OFFICE OF THE STATE ENGINEER AND SURVEYOR, }
ALBANY, N. Y., *January 20, 1887.* }

Hon. JAMES W. HUSTED,

Speaker of the Assembly:

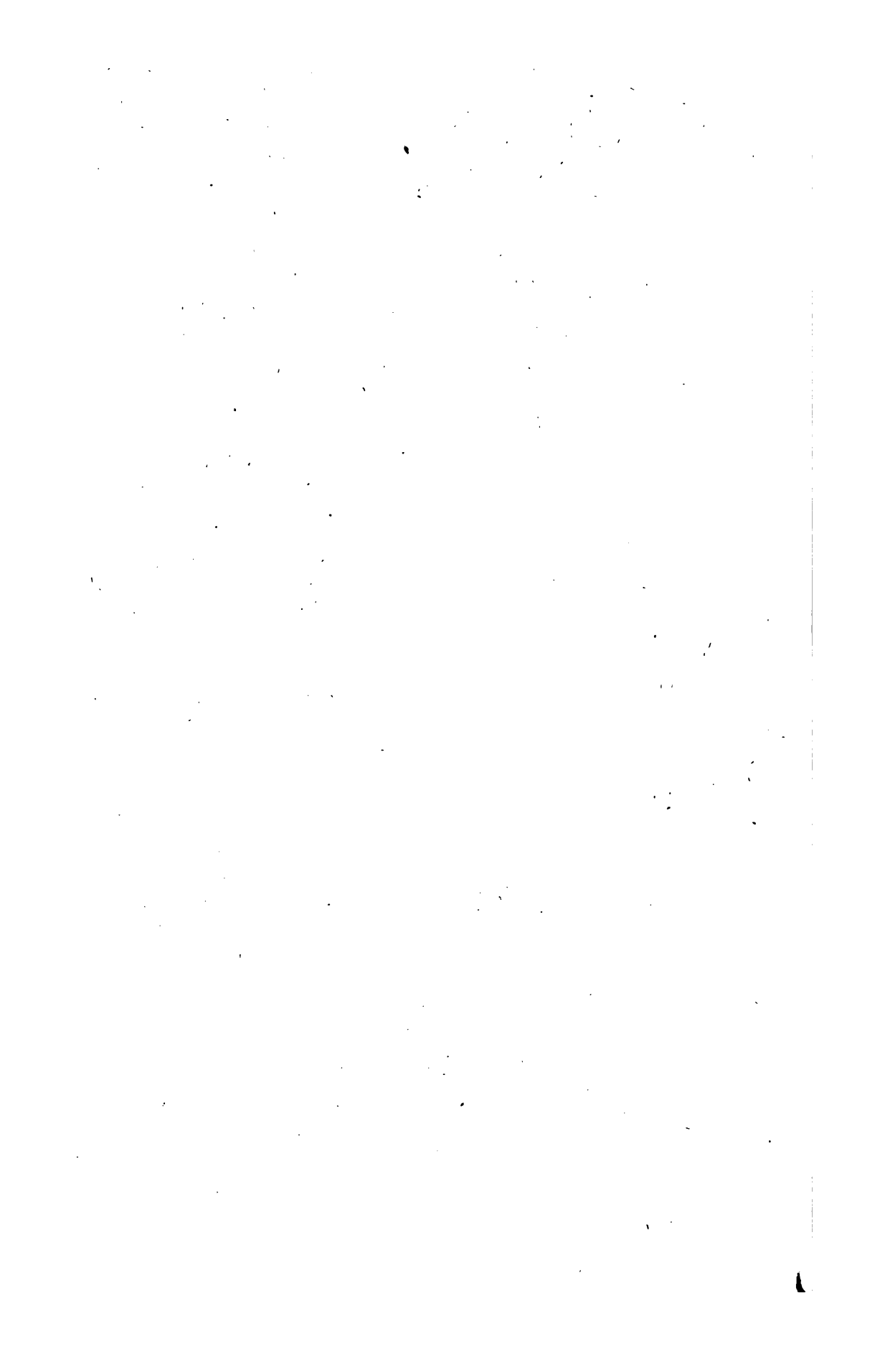
SIR.—I have the honor to submit herewith my Annual Report relative to the Canals of the State for the fiscal year ending September 30, 1886.

Very respectfully,

Your obedient servant,

E. SWEET,

State Engineer and Surveyor.



REPORT.

To the Honorable the Legislature of the State of New York:

Pursuant to law I have the honor to submit the annual report of this department for the past year.

OPERATIONS OF THE CANALS.

The business of the canals during the past season is measured in the manifest improvement observable in all the industrial interests of the State. The total canal tonnage during the season of navigation just ended, aggregated 5,293,982 tons, or 562,198 tons more than was carried by canal last year.

The rate of freight has increased in a still greater proportion, it having averaged $\frac{2\frac{1}{2}}{100}$ of a cent per ton per mile last year, and $\frac{3\frac{1}{4}}{100}$ of a cent per ton per mile this year. The business of the New York Central and Erie Railroads, which are competitive to the canals, has also increased in quantity and value, but not so much as that of the canals. The accompanying table shows the comparative tonnage of the canals and of the competing railroads for the last twenty-five years, covering the period which has elapsed since the enlargement of the Erie canal:

Years.	Freight by Canals—Tons.	Freight by Railroads—Tons.
1862	5,598,785	3,020,388
1863	5,557,692	3,264,700
1864	4,852,941	3,727,946
1865	4,729,654	3,609,640
1866	5,775,220	4,844,989
1867	5,688,325	5,152,472
1868	6,442,225	5,754,842
1869	5,859,080	6,594,094
1870	6,173,769	8,974,505
1871	6,467,888	9,376,264
1872	6,673,370	9,958,239
1873	7,364,782	11,835,426
1874	5,804,588	12,478,954
1875	4,859,858	12,241,900

Years.	Freight by Canals—Tons.	Freight by Railroads—Tons.
1876	4,172,129	12,776,498
1877	4,955,963	12,533,807
1878	5,171,320	13,845,981
1879	5,362,372	17,228,394
1880	6,457,652	19,248,930
1881	5,179,192	22,678,202
1882	5,467,423	23,225,631
1883	5,664,056	24,503,063
1884	5,009,488	22,123,895
1885	4,751,784	21,071,446
1886	5,293,982	*25,443,353

NAVIGATION.

The canals were opened on the 1st day of May and closed on the 1st day of December, 1886. There have been no serious breaks on any of the canals during the year, and the only local interruptions to their navigation, of any importance, have been as follows:

June twenty-eighth, navigation was delayed several hours by the breaking away of part of the floor of the Yatesville aqueduct near Sprakers.

July twenty-fourth and twenty-fifth, a delay of about thirty-six hours occurred at Ilion, on account of necessary repairs to the foundations of lock No. 44; and

August eighth and ninth a delay of about the same duration occurred at Syracuse by the undermining of the foundations of lock number forty-seven, which prevented the alternate filling of the chambers of the lock.

WATER SUPPLY.

Owing to the absence of any considerable drouth during the past season there has been no detention on account of insufficiency in the supply of water to the canals, but the detailed report of Division Engineer Richmond, herewith inclosed, shows by how narrow a margin an absolute stoppage of navigation on the Rome level of the Erie canal was prevented, and emphasizes the importance of immediately finishing the reservoir at Forestport, to which I have called the attention of your honorable body in both of my previous annual reports. An appropriation of \$45,000 is respect-

*Includes eleven months business of the West Shore Railway.

fully recommended for this purpose. The leaky and unsafe condition of the wooden dam at Little Falls, by which water from the Mohawk river is diverted to feed the canal from Little Falls to St. Johnsville, makes it my duty to recommend that it be rebuilt in a permanent manner of stone. I have prepared plans for this purpose, and respectfully recommend an appropriation of \$15,000 for carrying them into effect. In this connection I beg leave to renew the recommendation of my last report that the unexpended balances of former appropriations for the ordinary repairs of the canals be set apart and devoted to the cleaning out and restoring to its original dimensions the prism of the Erie canal between Lockport and Montezuma. The accumulation of sediment in this part of the canal probably exceeds 400,000 cubic yards, and by reducing the size of its channel and feeding a great mass of aquatic vegetation it retards the flow of water and renders the proper feeding of the portion of the canal between Rochester and Montezuma difficult and uncertain.

CONDITION OF THE CANALS.

The general condition and efficiency of the canals have been well maintained during the year. For a detailed description of the ordinary repair work of the year reference is invited to the reports of the several division engineers which are inclosed herewith.

IMPROVEMENTS MADE AND IN PROGRESS UNDER SPECIAL LAWS.

During the year iron bridges have been built under special appropriations at the Lumber District, Albany, at West Troy, at Herkimer, at Pinnacle avenue, Rochester, and at Main street, Lockport, and the approaches to the Catherine street bridge at Syracuse have been completed. The dam on the Beaver river at Stillwater has been finished, and ditches built at Cowassalon swamp at Mentz and at Montezuma. A section of the Champlain canal at Fort Ann has been widened and strengthened. The improvement of Woodchuck Bend has been completed, and a waste-weir built at Eagle Harbor. The appropriations for these works aggregated \$55,700, and they have all been completed within the appropriation. The improvements in progress under special laws consist of iron bridges, one over the Mohawk river at

Cohoes, one at Monroe avenue, Rochester, a sewer at Saxton street, Rochester; a dyke and retaining wall at Lansingburgh; a retaining wall at Cohoes; dredging the canal level between Fort Edward and Fort Ann; a stop gate at Syracuse, and the lengthening of locks 47, 48, 49 51 and 52 of the Erie canal, and locks 3, 4 and 5 of the Oswego canal; all to be finished before the opening of navigation in 1887. The appropriations for these works in progress aggregate \$300,500, and the contracts are all let at prices that will ensure their completion for a considerable less aggregate sum than that appropriated. The sum of \$5,000 was appropriated by chapter 336 of the Laws of 1886, for constructing a lift-bridge over the Champlain canal at Mechanicsville, but the amount to which the law limits the expenditure is found to be insufficient to make the contemplated improvement.

IMPROVEMENTS RECOMMENDED.

In addition to the improvements above recommended for ensuring an adequate supply and certain distribution of feed water for the canal, I beg leave to call the attention of the Legislature to the following special works that appear to me to be required for the safe and efficient working of the canals, and to require special appropriations for their execution:

At Buffalo the extraordinary storms of November last washed away the shore and encroached on the towing path of the canal to such an extent as requires an extension of about 200 feet southerly of the sea wall constructed there under special appropriation under the law of 1885, to complete which the sum of \$10,000 will be required.

At St. Johnsville the wooden waste-wier is leaky and unsafe, and should be replaced by a permanent structure of stone masonry, which will cost \$3,500.

At lock No. 33 the bulk-head and sluice at the head of the lock are in very bad condition and located too near the lock for the security of navigation, and should be rebuilt 150 feet further from the lock, and will cost about \$2,500

SURVEYS AND BOUNDARIES.

The recommendation of my last report that the records of the State Survey and of the Adirondack Survey be put in available form and deposited in this office is being satisfactorily carried out

so far as the first named survey is concerned, under chapter 414 of the Laws of 1886, and I recommend that the records and property of the Adirondack Survey be also deposited in this office in order that the notes and results may be put in intelligible form, and such as have any value be made available to the public.

Under chapter 449, of the Laws of 1886, relating to the preservation of monuments on the boundaries of this State, copies of the law, accompanied by suitable instructions and by a description of the State monuments adjacent to their respective towns, were sent to the Supervisors of all towns adjoining the artificial boundaries of the State. Reports have been received from the greater number of them. The law provides no sanction for its enforcement, nor does it or any other law that I know of provide for any means of replacing or renewing monuments that may be removed or destroyed. It would seem desirable, therefore, that it should be amended to provide suitable penalties for non-compliance with its provisions, and further to give the State Engineer authority to repair, restore or replace any monuments that may be found to have been injured or removed. The cost of such repairs or renewals to be a charge upon the town or towns to which the monument is adjacent. An investigation of these monuments shows that our artificial boundaries are all very well marked by permanent monuments of stone or iron except that portion of the boundaries which divides New York and Massachusetts. This Massachusetts and New York boundary, except the portion two and one-half miles in extent, and forming the eastern boundary of the Boston Corners tract, which was ceded by Massachusetts to New York in 1853 and on which three stone monuments were set in that year by the Commissioners appointed by the two States for its determination, has never had permanent monuments set upon it. The line was carefully determined by competent Commissioners authorized by the two States in 1787, but the only marking the line then received or ever since has received by competent authority was by stakes and stones at intervals of a mile or more apart and a very few blazed trees. It should be re-established by the joint authority of the two States and marked at proper intervals and at accessible points by permanent monuments.

THE WORK OF THE DEPARTMENT.

In addition to planning and supervising all the ordinary repairs and special improvements of the State canals, this department has attended to the engineering work of the Hudson River Improvement, and the numerous public improvements in various parts of the State whose execution has been intrusted by the Legislature to the Superintendent of Public Works or the State Engineer, and has made numerous surveys and has furnished expert evidence before the Board of Claims in cases in which the State is a party. All the details of the engineering force and its operations and expenses will be found in the accompanying reports of the Division Engineers. A summary of the engineering expenses on account of the canals for the year ending September 30, 1886, is attached hereto, as well as a table showing the net financial results of the canal ventures of the State from their inception until the end of the last fiscal year.

SUMMARY of Engineering Expenses of the New York State canals for the fiscal year ending September 30, 1886.

For ordinary repairs, Eastern Division.....	\$9,204 81
For ordinary repairs, Middle Division.....	6,110 54
For ordinary repairs, Western Division.....	9,263 60
Total for ordinary repairs.....	<u>\$24,578 95</u>
For extraordinary repairs, Eastern Division.....	\$1,227 16
For extraordinary repairs, Middle Division.....	3,905 81
For extraordinary repairs, Western Division.....	None.
Total for extraordinary repairs.....	<u>\$5,132 97</u>
The aggregate expenditures for the engineering work of the Hudson river improvement for the calendar year ending January 1, 1887, have been.....	<u><u>\$3,784 59</u></u>

TABLE showing the total cost for construction, maintenance and operation of the several State canals and their total revenues from their inception to September 30, 1886.

	Total cost for construction, maintenance and operation.	Total revenues from all sources.
Erie and Champlain canals..	\$95,040,407 63	\$130,930,993 37
Oswego canal.....	8,082,215 08	3,717,906 93
Cayuga and Seneca canals..	3,017,161 60	1,054,800 15
Black River canal.....	5,645,528 75	305,525 54
Genesee Valley canal.....	9,569,948 52	859,612 30
Chemung canal.....	3,428,252 41	525,425 97
Chenango canal.....	6,886,280 83	740,717 06
Oneida River improvement	263,242 80	217,061 34
Oneida Lake canal.....	580,626 05	65,188 47
Baldwinsville canal.....	39,519 94	1,261 48
Crooked Lake canal.....	821,271 13	45,352 71
	<hr/> \$133,374,484 74	<hr/> \$138,463,845 32

The above statements of cost do not include the sums paid for interest on canal loans which have been supplied by the surplus canal revenues and by taxation.

There has been raised by direct taxes for canals..	\$46,460,327 53
There has been raised by indirect taxes for canals.....	5,721,007 10

Total by taxes.....	\$52,181,334 63
---------------------	-----------------

The canal revenues have been applied to general purposes of the State government to the extent of.....	18,850,411 94
--	---------------

Leaving of State revenues applied to canals..	\$33,330,922 69
Sept. 30, 1886, there remained of the canal debt, less sinking fund.....	3,253,436 18

Leaving net loss through the canals.....	\$36,584,358 87
--	-----------------

All of which is respectfully submitted,

E. SWEET,

State Engineer and Surveyor.

EASTERN DIVISION.

ANNUAL REPORT OF THE DIVISION ENGINEER, NEW YORK STATE
CANALS, FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1886.

ALBANY, *October 1, 1886.*

Hon. E. SWEET,

State Engineer and Surveyor :

SIR.—I have the honor to transmit herewith my annual report for the fiscal year ending September 30, 1886.

Yours respectfully,

JOHN R. KALEY,

Division Engineer.

DESCRIPTION OF THE EASTERN DIVISION.

The limits of this division remain as fixed by the Canal Board in 1876, as described in my last report, and the number of miles of navigable canals, river improvements and feeders situated therein is as follows:

	Miles.
Erie canal, Albany to east line of Oneida county.....	106.243
Port Schuyler side-cut.....	.350
Albany basin.....	.770
Champlain canal, including Waterford side-cut and Cohoes and Saratoga dams.....	66
Pond above Troy dam	3
Glens Falls feeder and pond.....	12
Total.....	188.363

EXTENT OF FEEDERS NOT NAVIGABLE.

	Miles.
Mohawk river at Rexford Falls .....	.39
Mohawk river south side at Little Falls.....	.19
Mohawk river at Rocky Rift.....	3.92
Schoharie creek.....	.63
Total.....	5.13

ERIE CANAL — WATER SUPPLY.

The sources of supply on this division remain as stated in my last report:

The supply has been uniformly good, except between locks No. 34 and No. 39, this portion of the canal being dependent for its supply on the feeder at Little Falls. Owing to the large amount of leakage through the old wooden dam at this point, in times of low water, a sufficient head cannot be maintained in the pond to maintain the proper level of water in the canal.

CHAMPLAIN CANAL — WATER SUPPLY.

There has been no change in the sources of supply on this canal since my last report.

The supply from the Hudson river through the Glens Falls feeder, has been greatly increased by deepening the canal near the guard lock and by stopping many leaks through fissures in the rock bottom.

The supply of water for this canal has been ample throughout the season.

REPAIR SECTIONS — ERIE CANAL.

There has been no change during the past year in the location of lines dividing the several repair sections on this canal.

ALBANY BASIN.

Although a large amount of dredging, under the supervision of the Superintendent of Public Works, has been done here during the year the nuisance spoken of in my last report still exists, and I would renew my recommendation that the attention of the Legislature be again called to the necessity of taking action to abate the same.

ERIE CANAL LOCKS.

The locks on this division with some few exceptions, as noted below, are in good repair.

A brief description is given here of what has been done during the year and what is necessary to be done to place the locks on this division in good repair.

REPAIRS MADE DURING THE YEAR.

- Lock No. 3. Four gates renewed.
Lock No. 5. Two gates renewed.
Lock No. 10. Two gates renewed.
Locks Nos. 13, 16, 18. Two gates renewed in each.
Lock No. 19. One gate renewed and bulk-head repaired.
Lock No. 20. One gate renewed.
Lock No. 21. Two gates renewed and bulk-head repaired.
Lock No. 22. One gate renewed and bulk-head repaired.
Lock No. 24. Bulk-head repaired.
Lock No. 25. Two gates renewed and bulk-head repaired.
Lock No. 27. Two gates renewed and bulk-head repaired.
Lock No. 28. Two gates renewed, bottom taken up, grouted and replanked.
Lock No. 29. One gate renewed.
Lock No. 32. One gate renewed, bottom taken up, grouted and replanked.
Lock No. 34. One gate renewed.
Lock No. 36. Bottoms of lock and culvert replanked and apron repaired.
Lock No. 37. Bottoms of lock repaired.
Lock No. 38. Bottoms of both locks, aprons and mitre-sills repaired.
Lock No. 39. Left lock and culvert bottoms taken up, grouted, and the bottom of right lock repaired.
Locks Nos. 40 and 41. One gate renewed in each.
Lock No. 44. During the month of July much trouble was experienced working this lock ; being unable finally to operate the gates, due to a current of water passing from one lock to the other, the water was drawn from the levels above and below and an examination revealed the fact that the entire head of the lock was undermined. The insertion of the "Heath Tumble Gate" into this lock, some years ago, required the removal of a portion of the masonry ; this work properly consisted of cutting a few checks to receive timbers and should have been done carefully and neatly, instead of this it was done in an unworkmanlike manner and the masonry badly shattered. This blunder materially aggravated, if it did not wholly cause the trouble.

The planking was taken up and it was found that thirty-five cubic yards of material had been washed out from between and below the timbers. The hole was filled with broken stone thoroughly grouted and the difficulty apparently overcome.

I think further work should be done here and will refer to the same hereafter.

ERIE CANAL — LOCKS.

Repairs Necessary to be Made.

Lock No. 4. The bottom should be examined to locate leakage and proper means taken to stop the same.

Lock No. 11. Remains in the same condition as stated in my report of last year. I would urge the recommendation therein stated.

Locks Nos. 15 and 16. The leakage mentioned in my last report still continues. These walls should be repaired at the close of navigation.

Lock No. 17. The stone filling of bulk-heads at both ends of this lock has settled considerably and should be restored, level with the lock walls.

Lock No. 19. Needs a new bulk-head at the head.

Lock No. 21. The bottom is undermined. The plank should be taken up and the voids filled.

Lock No. 24. Needs a new bulk-head at the head.

Lock No. 25. Needs a new bulk-head at the head.

Lock No. 27. Needs a new bulk-head.

Lock No. 28. Needs new lower gates.

Lock No. 31. Needs new lower gates.

Lock No. 32. Needs new lower gates. The bulge in the walls of the left lock still continues to exist, as stated in my last report. Large boats are compelled to pass through one lock.

Lock No. 33. The upper gates should be renewed and the bulk-head, at the head, be rebuilt.

Lock No. 34. Same as No. 33, and also should have a new bottom put in.

Lock No. 39. This lock should be pumped out, the plank bottom taken up, foundation carefully examined and all voids below the planking filled. Entire new planking will probably be required.

Lock No. 40. Same recommendation as for No. 39.

Lock No. 42. The apron at the foot of the lock needs new filling and new planking.

Lock No. 44. Owing to the fact that the head of this lock was undermined during the year and to the difficulty experienced in making proper repairs in cases of this kind during the season of navigation, I would recommend that this structure be carefully examined at the close of navigation and that excavation be made at the head of the lock and a permanent cut-off be placed therein. In most cases of this kind, where careful examinations have been made, the masonry at the heads of the locks has not been placed low enough to secure a proper cut-off.

Lock No. 45. This lock is in the same condition as reported last year and should have immediate repairs.

Nearly all the locks on this division of the Erie canal need repointing. I would recommend that the same be done and with Portland cement.

ERIE CANAL — DAMS.

Dam No. 1. Located at Rexford Flats, across the Mohawk river. This structure is in good condition ; it was necessary to make few repairs to the same during the year. A new fish-way will, the coming season, be placed in this dam by the "McDonald Fish-way Company" of Washington, D. C. This company will also place a fish-way in the Schoharie creek dam.

Dam No. 2. Located at Fort Hunter, across Schoharie creek. I made a careful examination of this dam and found it to be in need of immediate repairs. The entire coping and cover to the apron should be renewed.

The apron cover is mostly soft maple and badly decayed and spongy. The stone filling in the apron has settled about one foot and should be raised.

This dam was lengthened by Contractor James P. Buck ; contract signed December 8, 1870 ; part of the abutment of the old dam was not removed, the new work being laid over it ; at this place about fifteen feet of the apron has broken away.

I would respectfully recommend that the entire apron deck and coping be renewed, coping sticks to be covered with three-inch plank, a new binder placed on the up stream end of the same, and two new ridge pieces put in ; all of the above to be of oak. Also, that one new hemlock longitudinal timber be placed under the lower end of the apron sticks, and that others be added where possible, from any of the old timber found to be suitable, and that the stone filling be replaced to the proper level. I estimate the

following quantities of materials necessary to make the above repairs, as recommended :

Engineer's estimate of quantities for repairs to the dam across the Schoharie creek at Fort Hunter.

Quantities.	Items.
295, 344 feet	B. M. white oak timber and plank.
7, 032 feet	B. M. hemlock timber and plank.
477 cubic yards	loose stone filling.
28, 377 pounds	wrought iron.

Dam No. 3. Located five miles east of Little Falls, across the Mohawk river, and known as the Rocky Rift feeder dam.

I would renew my recommendation of two years ago, that the dam be raised two feet; also, that a new bulk-head be built. Some repairs are needed on the vertical wall connected with this structure.

Dam No. 4. At Little Falls, across the Mohawk river. This dam is divided in two parts by an island, is composed of logs, brush and gravel, is in an unsafe condition and liable to break away at any time. There is a large waste of water through this structure, and its care is a source of much labor and expense. I would respectfully recommend, as in my report of last year, that the same be rebuilt of stone on a line below the old structure, and that the Legislature be asked to appropriate the sum of fifteen thousand dollars (\$15,000) for this purpose, in accordance with the engineer's estimate of the same, given below.

Engineer's estimate for rebuilding of stone the wooden dam across the Mohawk river, at Little Falls :

Quantities.	Items — Price.	Amounts.
1	Bailing and draining, \$1,000	\$1,000 00
100 cubic yards	excavation, earth, 25c	25 00
225 cubic yards	excavation, rock, \$2	550 00
50 cubic yards	excavation, loose stone, 75c	37 50
250 cubic yards	embankment, 40c	100 00
80 cubic yards	paving in cement, \$4	320 00
50 cubic yards	concrete, \$6	300 00
50 cubic yards	rubble masonry in cement, \$5	250 00
900 cubic yards	coursed masonry, including coping, \$11	9,900 00
3,500 pounds	Wrought iron, in work, 10c	350 00
		<hr/>
	Add 12 per cent for engineering, etc.	\$12,832 50 1,539 90
	Total	<hr/> <u>\$14,372 40</u>

Remark. — Dam No. 2 is 585 $\frac{7}{10}$ feet long between abutments, instead of 575 feet, as stated in former reports.

ERIE CANAL — AQUEDUCTS.

No. 1. Lower Mohawk, ordinary repairs have been made on this structure during the year. The trunk will soon need renewing, and the timber covering on the piers, being much worn by the action of ice, should be replaced.

No. 2. Same remarks and recommendations as for No. 1, except the piers, which have been retimbered during the year.

No. 4. Sansai Kill, between locks No. 25 and No. 26, known as Hoffman's aqueduct. Slight repairs are needed to the masonry on the berme side. The trunk was taken up and the channel of the creek cleaned, thereby enlarging the water-way.

No. 7. Leonardson creek, known as "Yatesville aqueduct," between locks No. 30 and No. 31, at Yatesville. The floor timbers of this structure should be renewed. During the season of navigation several of these timbers broke away, causing a delay to navigation. The bridge over the tow-path part of the structure should be renewed, and the east abutment needs repairs. The creek channel at this structure is filled up and should be cleared.

No. 8. Leonardson creek, at Little Nose, known as Lasher's aqueduct, between locks No. 30 and No. 31. Same recommendations as for No. 7.

No. 10. Bowman creek, at Canajoharie, between locks No. 31 and No. 32. New timbers have been placed in this structure. There is a very extensive leak through the east abutment on the tow-path side. Several face stones have been displaced by the force of the water. I am of the opinion that it will be necessary to tear down and rebuild this abutment, but before doing so it would be well to tear down a section of the vertical wall connected with the abutment and make a thorough examination, as the leak might possibly be cut off from the canal side and the voids in the abutment filled with grout. The creek channel should be cleaned.

No. 12. Castle creek, between locks No. 35 and No. 36, requires new floor timbers, and creek channel should be cleaned. The sides have been replanked and a few floor timbers put in.

No. 15. Myer's creek, known as Frankfort aqueduct, between locks No. 45 and No. 46. The sides of the trunk should be replanked. The apron on the lower drop is in bad condition.

No. 16. Ferguson's creek, between locks No. 45 and No. 46. The trunk should have new sides and floor.

The bottoms of many of the aqueducts are placed so near the creek beds that it becomes necessary to clean out the creek channels each year, and to remove the trunks at the close of navigation.

ERIE CANAL SPILLWAYS AND WASTE-WEIRS.

No. 2. Waste-weir at Schenectady street bridge, West Troy, between locks No. 2 and No. 3, should have a new bulkhead, with improved lift gates.

No. 4. Spillway and waste-weir at West Troy, out of the Mohawk basin into the Hudson river. The bulkhead has been badly damaged by ice and should be replaced by one on the improved plan.

No. 6. Spillway and waste-weir six and one-half chains west of lock No. 9. Bulkhead has been renewed and masonry repaired.

No. 8. Spillway and waste-weir about 400 feet above lock No. 20 is in an unsafe condition; has been reported several times, and I deem it urgent to recommend that the same be taken down and rebuilt.

No. 10. Waste-weir and spillway, with culvert beneath running under canal, about one-quarter of a mile east of Port Jackson, between locks No. 27 and No. 28. The waste-weir and spillway portion of this structure is in an unsafe condition; it was found necessary to fill the same with gravel. I would recommend that the unsafe portion be taken down and rebuilt and have made plans and estimate for the same. (See estimate below.)

Engineer's estimate for rebuilding the waste-weir and spillway portion of the combined culvert and waste-weir, one-quarter of a mile east of Port Jackson:

Quantities.	Items — Price.	Amounts.
1.....	Bailing and draining, \$25	\$25 00
900 cubic yards	excavation, including old foundation and old vertical wall, 25c.....	225 00
100 cubic yards	excavation, old masonry, 75c.....	75 00
325 cubic yards	embankment, 20c.....	65 00
220 cubic yards	puddled earth, 20c.....	44 00
20 cubic yards	procuring and puddling, 50c.....	10 00
138 cubic yards	coursed masonry, including coping, \$9.50	1,292 00
75 cubic yards	vertical wall in cement, \$5.50.....	412 50
28 cubic yards	vertical wall, dry, \$4.....	112 00
1,280 pounds....	Wrought-iron, 8c.....	102 40
600 pounds....	Cast iron, 6c.....	36 00
300 pounds....	Spikes and nails, 5c.....	15 00
2,650 feet B. M..	White oak timber and plank, \$50.....	132 50
3,550 feet B. M..	White pine timber and plank, \$35.....	124 25
8,500 feet B. M..	Hemlock, \$18	153 00
Total.....		<u>\$2,828 65</u>

Description of the Above Work.

The present structure is to be taken down to a level of about three and one-half feet below canal bottom. The portion taken down is to be rebuilt of coursed masonry, consisting of two abutments and one wooden bulkhead, with three improved wrought-iron lift-gates, three by four feet in the clear, each. Below this level the parapet and wing walls are to remain undisturbed. The stone taken from the old structure are considered unfit to be used in the new work and are to be used for other repairs.

No. 12. Waste-weir located about three-quarters of a mile east of lock No. 33. Described in last report. I would renew my recommendation of that year.

No. 14. Wooden waste-weir and spillway, on the tow-path, about 2,400 feet west of lock No. 33. This structure was built entirely of wood several years ago; it was found necessary to fill it with gravel immediately after construction. The tow-path bank at this point is on the river edge and twenty feet above water surface in the Mohawk river. The old wooden structure is liable to decay and cause a serious break. I would recommend that this structure be rebuilt of stone and have made plans and estimate for the same. (See estimate below.)

Engineer's estimate for rebuilding of stone the wooden waste-weir and spillway situated at St. Johnsville, about 2,400 feet west of lock No. 33.

Quantities.	Items — Price.	Amounts.
1.....	Balling and draining, \$25	\$25 00
750 cubic yards	all excavation, includ'g walls and waste-weir, 25c.	187 50
150 cubic yards	embankment, 20c.....	30 00
60 cubic yards	lining and gravelling, 50c.....	30 00
90 cubic yards	puddled earth, 20c.....	18 00
26 cubic yards	procuring and puddling, 50c.....	13 00
25 cubic yards	concrete, \$8	150 00
160 cubic yards	coursed masonry, including coping, \$9.50.....	1,520 00
80 cubic yards	vertical wall in cement, \$5.50.....	440 00
28 cubic yards	vertical wall, dry, \$4.. ..	112 00
1,950 pounds....	Wrought iron, 8c.....	156 00
1,200 pounds....	Cast iron, 6c.....	72 00
300 pounds....	Spikes and nails, 5c.....	15 00
4,850 feet B. M..	White oak timber and plank, \$50.....	242 50
4,950 feet B. M..	White pine timber and plank, \$35.....	173 25
8,800 feet B. M..	Hemlock timber and plank, \$18.....	158 40
Total		<u>\$3,842 65</u>

Description of the Above Work.

The new work to consist of two abutments and one center pier of coursed masonry; to have two improved bulkheads with lift-gates, each to be thirty-three by thirty-three inches clear.

ERIE CANAL — CULVERTS.

Remark. — The numbers used to designate culverts are as given in report for fiscal year ending September 30, 1884.

I would renew my recommendations of last year for the following culverts on this division :

No. 21. At Clute's dry dock, 515½ chains west of lock No. 18.

No. 22. 652 chains west of lock No. 18.

No. 28. 300 chains west of lock No. 22.

No. 37. 270 chains west of lock No. 26.

No. 45. 225 chains west of lock No. 27, at Port Jackson.

No. 69. 172 chains west of lock No. 33.

No. 70. 210 chains west of lock No. 34.

No. 12. 16 chains west of lock No. 3.

No. 60. 224 chains and 80 links west of lock No. 32. This structure is a stone semi circular arch of four foot chord. The masonry on the north end should be taken down and rebuilt.

Many of the culverts have had slight repairs during the season.

The channels and ditches above and below, many of them should be cleaned.

In many cases the masonry should be repointed.

ERIE CANAL — BRIDGES.

The description and designation of bridges remain as given in my report for the fiscal year ending September 30, 1884.

The number of bridges has been increased during the past year by the addition of two, erected on sites where none formerly had been, viz. :

First. — A wrought iron railroad bridge built by the D. & H. C. Co., above lock No. 2, on the line of its track to the new iron works on Breaker Island.

Second. — A wrought iron foot bridge, at Middle street, West Troy, built in pursuance of authority granted by chapter 511, Laws of 1885, appropriating \$600.

The following bridges have been rebuilt or repaired during the past year; work being done by the Superintendent of Public Works, unless otherwise noted :

Between Locks No. 1 and No. 2.

Station 82+90. Suspension foot bridge in Lumber District, Albany. New superstructure and towers built in compliance with act, chapter 246, Laws of 1885.

The entire wood-work of this bridge was rebuilt, and the wooden towers replaced by iron work. This work as well as the iron foot bridge at Middle street, West Troy (heretofore spoken of), was done by contract with the Groton Iron Bridge Company of Groton, N. Y., at a cost, for the two structures, of \$1,200 the same being the total amount of the appropriation for the two bridges.

Between Locks No. 2 and No. 3.

Swinging bridge on the upper side cut at West Troy. The entire wooden portion of this bridge was rebuilt shortly after the opening of navigation.

Between Locks No. 18 and No. 19.

Station 542+93. Wooden farm bridge. Rebuilt.

Station 633+80. Wooden farm bridge. Repaired.

Between Locks No. 22 and No. 23.

Station 304+98. Wooden street bridge, Jefferson street. Repaired.

Station 365+78. Wooden street bridge, Rotterdam street. Rebuilt.

Between Locks No. 24 and No. 25.

Station 99+18. Wooden road bridge, "Van Slyke's." Rebuilt.

Between Locks No. 25 and No. 26.

Station 40+38. Wooden farm bridge, "Turnbulls." Rebuilt.

Station 73+89. Wooden farm bridge. Rebuilt.

Station 393+64. Wooden farm bridge, "French's." Repaired.

Between Locks No. 27 and No. 28.

Station 203+26. Wooden street bridge, iron chord. Rebuilt.

Between Locks No. 30 and No. 31.

Station 123+43. Wooden farm, "Putman's." Rebuilt.

Station 493+70. Wooden street, at Franklin street, Fultonville; the old bridge was removed and a wrought iron structure

with sidewalk built by the Niagara Bridge Company of Buffalo, New York, at a cost of \$1,748.

Station 421+08. Iron chord bridge, at Fultonville steam mill. Rebuilt.

Station 828+13. Wooden farm bridge, "Miles Yates." Rebuilt.

Between Locks No. 31 and No. 32.

Station 341+76. Wooden farm, "Bullocks." Rebuilt.

Station 370+34. Wooden farm, "Wagner's." Rebuilt.

Between Locks No. 32 and No. 33.

Station 59+64. Wooden road, iron chord, "Clark's." Rebuilt.

Between Locks No. 39 and No. 40.

Station 97+32. Wooden farm, "Casler." Rebuilt.

Between Locks No. 41 and No. 42.

Station 109+25. Herkimer road bridge. My last report states that the contract for rebuilding this bridge had been awarded to O. F. Hilt, of Greenbush, New York. The work has been done as proposed and a substantial iron structure erected. The abutments were raised and lengthened. The river bridge was raised to conform to the new grade and the approaches improved. The whole work was done at a cost of \$1,925.25. Act, chapter 279 Laws of 1885 appropriated \$2,000 for this work.

Between Locks No. 45 and No. 46.

Station 327+95. Wood farm, "Wesley's." Rebuilt.

THE FOLLOWING BRIDGES SHOULD BE REBUILT.

Between Locks No. 2 and No. 3.

Station 243+53. Wooden street at Spring street, West Troy. This bridge is old and unsafe and should be rebuilt as soon as possible. Most of the heavy traffic at this point passes over this structure. I would recommend that it be replaced by a substantial iron structure. The tow-path abutment is located only seven feet back of the inner angle line and when the bridge is rebuilt the abutment should be set back to a line at least fourteen feet from the inner angle.

Between Locks No. 17 and No. 18.

Wooden farm with iron chords located about four chains below lock No. 18. This structure is unsafe; was built about thirteen years ago; should be rebuilt this season.

Between Locks No. 22 and No. 23.

Station 337+22. Wrought-iron street, two roadways and two sidewalks. This structure is located on the main street of Schenectady. The roadways are each seventeen feet centers and the sidewalks fourteen feet, ten inches centers. Span out to out of bridge is seventy-six feet six inches.

The trusses are too light to carry a load which might reasonably be expected to come upon a bridge of these dimensions and in this location. The needle beams were none too strong when originally built and are now badly weakened by rust. The bottom part of this bridge was never painted, which fully accounts for its serious deterioration by rust. I consider it very important that this bridge be strengthened.

Station 354+24. Wooden street, with iron chords, at Church street, Schenectady. Woodwork should be renewed.

Between Locks No. 24 and No. 25.

Station 181+54. Wooden road, iron chords, "Crawford's." Woodwork should be renewed.

Station 218+14. Wooden farm. Should be rebuilt.

Between Locks No. 25 and No. 26.

Station 185+78. Wooden road, iron chords, "Patterson's." Woodwork should be renewed.

Between Locks 30 and 31.

Station 36+98. Wooden farm, "Yates'." Should be rebuilt.

Between Locks No. 31 and No. 32.

Station 49+14. Wooden farm, "Van Evera." Should be rebuilt.

Between Locks No. 32 and No. 33.

Station 89+88. Wooden farm, "Lipes." Should be rebuilt.

Station 337+28. Wooden farm, "Smith's." Should be rebuilt.

Between Locks No. 34 and No. 35.

Station 8+19. Wooden road, iron chords, "Mindenville." Woodwork should be renewed.

Station 71+69. Wooden farm, iron chords, "Snell's." Woodwork should be rebuilt.

Station 128+44. Wooden farm, "Smith's." Should be rebuilt.

Station 217+40. Wooden farm, iron chords, "Snell's." Should be rebuilt.

Station 241+40. Wooden farm, iron chords, "Green's." Should be rebuilt.

Between Locks No. 35 and No. 36.

Station 34+97. Wooden farm, iron chords, "Fox's." Should be rebuilt.

Station 290+16. Wooden road, iron chords, "Fink's Basin." Woodwork should be renewed.

Between Locks No. 39 and No. 40.

Station 6+16. Wooden street, iron chords, "Bellenger street." Woodwork should be renewed.

Station 178+38. Wooden Farm, "H. Casler." Should be rebuilt.

Between Locks No. 40 and No. 41.

Station 73+4. Wooden farm, iron chords, "Snell's." Woodwork should be renewed.

Station 160+39. Wooden farm, "Small's." Should be rebuilt.

Between Locks No. 41 and No. 42.

Station 30+13. Wooden farm, iron chords, "Steele's." Woodwork should be rebuilt.

Station 223+25. Wooden street, "Otsego street," at Mohawk. Should be rebuilt.

Between Locks No. 43 and No. 44.

Station 31+24. Wooden farm, iron chords, "Myers." Should be rebuilt.

Between Locks No. 44 and No. 45.

Station 45+75. Wooden farm, "Palmer's." Should be rebuilt.

Between Locks No. 45 and No. 46.

Station 74+65. Wooden road, iron chords, "Ferguson's." Woodwork should be renewed.

Many of the wooden bridges on this division of the canal need repainting. I would recommend that such be given two coats of white lead paint.

Most of the iron bridges also, are in need of paint.

ERIE CANAL — BRIDGE ABUTMENTS.

Since my last report, the berme abutment of bridge No. 123, station 241+76, between locks No. 31 and No. 32, "Bullock's bridge" has been rebuilt, the tow-path abutment raised, and both the approaches regraded by the Superintendent of Public Works.

The tow-path and berme abutments of the Franklin street bridge at Fultonville have been lengthened and raised to receive the new iron super-structure, heretofore spoken of, and the approaches regraded, by the Superintendent of Public Works.

The Herkimer road bridge abutments have been raised and lengthened by O. F. Hilt, under his contract heretofore spoken of.

The following bridge abutments urgently need attention and should be either torn down and rebuilt or extensively repaired. All of these are situated on the berme side of the canal, and most of them, in consequence of the fact that they are not founded deep enough, have settled and lean badly toward the canal.

Between Locks No. 18 and No. 19.

Station 542+93. Farm. Berme abutment.

Station 598+42. "Whitehead's dock." Berme abutment.

Between Locks No. 22 and No. 23.

Station 264+88. Road. Berme abutment.

Between Locks No. 25 and No. 26.

Station 117+40. Road bridge. "Byces'." Berme abutment.

Station 398+53. Farm bridge. "French's." Berme abutment.

Between Locks No. 28 and No. 29.

Station 138. Farm Bridge. "Voorhees'." Berme abutment.

Between Locks No. 31 and No. 32.

Station 7+46. Ferry street bridge at Spraker's. Berme abutment.

Station 49. Farm bridge. "Van Evera's." Berme abutment.

Station 475+40. Farm bridge. "Nellis'." Berme abutment.

Between Locks No. 32 and No. 33.

Station 337+16. Farm bridge. "Smith's." Berme abutment.

Between Locks No. 34 and No. 35.

Station 71+56. Farm bridge. "Snell's." Berme abutment.

Station 217+40. Farm bridge. "Shull's." Berme abutment.

Station 214+40. Farm bridge. "Green's." Berme abutment.

Between Locks No. 35 and No. 36.

Station 34+85. Farm bridge. "Fox's." Berme abutment.

Between Locks No. 40 and No. 41.

Station 160+40. Farm bridge. "Steel's." Berme abutment.

Between Locks No. 44 and No. 45.

Station 77+29. Frankfort street bridge, Ilion. Berme abutment.

Station 91+36. Litchfield street bridge, Ilion. Berme abutment.

Between Locks No. 45 and No. 46.

Station 296+60. Farm bridge, "Robinson's." "Berme abutment.

Many bridge abutments east of lock No. 27 should be repointed.

Nearly all of the abutments (except those rebuilt or repaired during the past four years) remain as stated heretofore, entirely too low to allow the required head room, and the bridges are blocked up with timbers.

ERIE CANAL — EXTRAORDINARY REPAIRS.

The following appropriations have been made by the Legislature during the past two years for extraordinary repairs on this division of the Erie canal.

Act chapter 279, Laws of 1885, appropriating \$2,000 for building an iron highway bridge at Herkimer. (See remarks under the head of bridges.)

Act chapter 246, Laws of 1885, appropriating \$600 for rebuilding the suspension foot-bridge in the Lumber District, Albany. (See remarks under the head of bridges.)

Act chapter 511, Laws of 1885, appropriating \$600 for building a foot-bridge at Middle street, West Troy. (See remarks under the head of bridges.)

Act chapter 424, Laws of 1886, appropriating \$3,000 for the purpose of removing obstructions from the bed of Mill creek in the city of Schenectady.

By the terms of the law the work was to be done without damage or injury to the foundations of the structures on said creek.

I have made careful examinations and surveys of this creek and have arrived at the conclusion that to make any material improvement to the present creek bed would cause serious damage to many of the structures on the line of said creek. I would respectfully call your attention to my report, maps and estimate on this subject submitted to you August 25, 1886.

Act chapter 544, Laws of 1886, appropriating \$2,000 for the construction of two fishways, one in the State dam, near the aqueduct, Rexford Flats, and one in the State dam at Schoharie creek.

Arrangements have been made with the McDonald Fishway Company of Washington, D. C., to construct the same.

ERIE CANAL — PRISM AND BANKS.

The tow-path has been very much improved during the year by the use of road-scrapers and a liberal supply of gravel. By the use of these road-scrapers, surplus material from the rear angle of the bank has been thrown toward the inner angle, raising the same to the proper grade and giving the top an inclination away from the canal, thereby securing good drainage. The tow-path bank is now in better condition than it has been for years back.

ERIE CANAL — SLOPE AND VERTICAL WALLS.

The slope and vertical walls remain in about the same condition as reported last year, with the exception of the following repairs:

About seventy-five feet of vertical wall in cement has been built on the tow-path side of the canal, extending from the head of lock No. 38, westerly, breaking the connection between the canal and the abandoned aqueduct. The old aqueduct tow-path bridge has been removed and the bank restored to the proper grade.

On the eastern end of the Little Falls feeder the old vertical wall, which retains the tow-path between the two arch culverts, for a distance of eighty-eight feet, and which was in a very bad condition, has been replaced by a substantial wall in cement.

ERIE CANAL — DOCKING.

The docking has been repaired at such points as was absolutely necessary to prevent the same from falling into the canal, but much of it, especially west of the city of Schenectady and at "Big Nose," is greatly in need of thorough repairs. I would recommend that vertical walls in cement be substituted for the same.

STATEMENT showing final accounts rendered during the year ending September 30, 1886, on account of work done on the Erie Canal, under contracts authorized by special acts of the Legislature and under ordinary repairs.

NAME OF CONTRACTOR.	Description of Work.	AUTHORIZED BY ACT OF LEGISLATURE.		Date of contract.	Date of final account.	Amount appropriated by the Legislature.	Amount of final account.	Excess of the appropriation over final account.
		Chapter.	Laws of.					
Groton Iron Bridge Co..	Suspension foot-bridge at Lumber Dist't, Albany.	246	1885	Oct. 23, 1885	Mar. 22, 1886	\$600 00	\$600 00	.....
Groton Iron Bridge Co..	Iron foot-bridge at Middle street, West Troy	511	1885	Oct. 23, 1885	Mar. 22, 1886	600 00	600 00	.....
Oscar F. Hilt.....	Iron road-bridge at Herkimer.....	279	1885	July 14, 1885	Dec. 17, 1885	2,000 00	1,925 25	\$74 75
Totals.....						\$3,200 00	\$3,125 25	\$74 75
Niagara Bridge Works...	Iron road-bridge at Franklin street, Fultonville..	Ordinary repairs		Feb. 18, 1886	May 1, 1886	.....	\$1,748 00	.....

WEST SHORE RAILWAY.

Since the date of my last report a reorganization of the old New York, West Shore and Buffalo Railway has been effected and the title of the corporation changed to the "West Shore Railway." Since the said reorganization the Superintendent of Public Works and State Engineer have accompanied the proper officers of this new corporation over that portion of the canal adjacent to which the New York, West Shore and Buffalo Railway was built, under permits granted by the late Superintendent of Public Works, in order to determine what work required of the railway company by said permits yet remained incomplected and to provide for the early completion of the same. As a result of this examination the following memoranda of work to be done by said West Shore Railway Company have been agreed to by the above-named officers of the State of New York and of the West Shore Railway Company, and arrangements have been made to secure the completion of the same during the coming winter.

Memoranda of notes of examination of points along the line of the Erie Canal, between Flint Hill and St. Johnsville, made June 29, 1886, by the Superintendent of Public Works and State Engineer of the State of New York and the General Manager, General Superintendent and Chief Engineer of the West Shore Railroad.

No. 1. At the wide-water, east of the east end of Flint Hill, the present openings of the berme bank are to be lowered to a depth of two feet below the water surface line.

No. 2. Complete the rip-rapping of the north railroad slope of the embankment, east of the east end of Flint Hill, and remove all rocks from the bed of the canal.

No. 3. The rock point at the east end of Flint Hill, some ten or twelve feet in length, to be cut back to the line of rock slope of the cut next west of the same and a good dry slope wall to be built from this cutting easterly to a certain rock lying on the berme bank, indicated by the Superintendent of Public Works, estimated to be one hundred feet long. The wall to be constructed on a line commencing seventy-two feet from the inner angle of the tow-path at the end of the rock cut and eighty feet from the same 230 feet easterly from said point of rock. Wall to commence at canal bottom and carried two feet above the water line.

No. 4. Along the rock slopes of the canal, at Flint Hill, the slopes to be trimmed and loose or shattered rock removed where open seams have developed. The debris rock to be disposed of over the tow-path bank.

No. 5. The shoulder of the railroad embankment, on north side of the tracks, at west end of Flint Hill, retaining wall, to be filled out to the inner edge of the top of the wall, so as to intercept water running behind the wall.

No. 6. At the west end of Flint Hill retaining wall, a good substantial slope wall to be constructed from canal bottom and carried up two feet above the water line. To commence about fifty feet west of the west end of the retaining wall and extend easterly to a point about seventy feet east of the end of the said wall, cutting off the projecting point and widening the water way. So much of the earth as may be needed to be placed against the retaining wall and dressed to a uniform slope, and the surplus over the tow-path.

No. 7. At Phillips' creek the channel of the stream between the railroad bridge and the river to be cleaned out to the original bed of the creek; also the water way of the culvert to be cleaned out to the foundation of the same, and such portions of the old high-way bridge abutment, as may be standing in the way, to be removed. Dry slope walls to be constructed from the present termination of the wing walls of the railroad bridge abutments on the north side to a junction with the wing wall of the canal culvert on the south side. The slope walls to commence at the foundations of the said structures and to be carried to high-water mark.

No. 8. At the first culvert west of Phillips' lock the apron of planking to be removed. The present paving between the main walls, commencing at the breast wall and extending about twenty-five feet down stream, to be replaced by heavy flat stones, laid with close joints and having a smooth top surface. So much excavation as may be necessary to be done back of the breast wall, and whatever masonry or concrete and grout, as may be needed to intercept water from going through the masonry, to be put in. A wing wall of masonry to be constructed on the north side, up stream, from the breast wall, similar to the wing on the

south side, one piece of coping to be put on. The water way to be widened and deepened back of the structure.

No. 9. At the east end of Yankee Hill wall, take down the wall at the bridge to water line, level and relay the same to a new "warped" batter to bring the top edge into the true line; complete coping of same and the slope wall behind the retaining wall.

No. 10. Some eight or ten iron drain pipes to be put in so as to leave them disposed at intervals of about 1,000 feet apart. The ditch on the south side of the railroad to be graded so as to drain to each pipe for a distance of 500 feet each way from the same (the said ditches and pipes to be of sufficient size to properly drain the work), the pipes to be placed under the track and carried through the retaining wall below the coping course. All the wooden drain boxes, formerly used and now in use, to be removed.

No. 11. The two open culverts near the large bulge in the retaining wall at Yankee Hill, constructed with silt walls, are to be cleaned out to the foundations and a suitable slope graded from the south end of the foundations of the wells to the bed of the stream above the same.

No. 12. The retaining wall at Yankee Hill, where the large bulge occurred in the same, is to have new coping put on; the material and character of the work to be the same as on the finished portion of the said walls, a slope wall to be constructed back of the retaining wall.

No. 13. The bulge in the retaining wall at the cross-over to be taken down to the water line level and relaid with a "warped" batter to bring the top edge into the true line and complete the coping and slope wall behind the same.

No. 14. The remaining 2,200 hundred feet of slope wall at Yankee Hill to be constructed on the same plan, and of the same character of work as the wall built last year, and such proportions of the slope wall constructed in 1885, that has been damaged by spring drainage and frost, to be relaid.

No. 15. The double arch culvert at Auriesville to be cleaned out, including the material between the walls south of it and the creek down the stream from the same.

No. 16. Auriesville creek, relay the upper portion of the dry retaining wall at the south corner of the wing wall, that has been

battered and knocked out of place by the ice. Back up the space behind the wall solidly to the top of the retaining wall back to the south corner of the bridge wing wall. Restore the defaced coping on the south parapet of the canal aqueduct, and repair the planking of the aqueduct apron under the railroad bridge.

No. 17. The box culvert, just west of the covered bridge at the Montgomery county poor house, to be taken up and relaid with an area as large as the canal culvert, and constructed with a suitable opening left in the same over the well of the canal culvert, for entering to clean the said canal culvert and which is to be kept clean by the railroad company.

No. 18. A retaining wall to be constructed in the canal, extending westerly about 450 feet from the west end of the west wing of the new abutment of the covered bridge, having winding wings to connect with the said abutment at the east of the berme bank of the canal. At the west end to widen out to a width of eighty feet at the water line for the main portions of the wall. Wall to be built high enough to catch the slope of the railroad embankment, to be of the same character of work and of the same plan as the retaining wall situated one and one quarter miles east of Fultonville.

No. 19. The retaining wall east of Fultonville, constructed in 1885, to be extended easterly on the same line of the present wall, 100 lineal feet; to be on the same plan and of the same character of work. After the extension is completed the entire wall to have a course of coping put on.

No. 19½. The canal culvert situated about half a mile east of Fultonville, which was entirely closed while constructing the railroad bridge, abutments near the same to be cleaned out, and kept clean by the said railroad company.

No. 20. The Yatesville creek, slope and rip-rap, the north bank of the creek, west and north of the north-east wing of the railroad abutment, extending westerly about fifty feet. West of the big elm tree, standing in the bank of the creek; wall to be hand laid.

No. 21. At the east end of the "Big Nose" retaining wall, a dry wing wall to be extended about thirty-three feet from the east of the present retaining wall, to terminate in the slope of the railroad embankment. Masonry to be laid in cement, and of the same character as the rest of the retaining wall.

No. 22. Along the highway on the north side of the tow-path between the two iron bridges opposite "Big Nose," build a tight board fence six feet in height along the line of the telegraph poles as they now stand. Join the fence at its westwardly end with the wing of the bridge abutment.

No. 23. At the crossing of the highway over the railroad east of Fort Plain, the present retaining wall to be extended about thirty-five feet eastwardly on the same line as the present wall.

No. 24. East of St. Johnsville. A wide water way to be made by first constructing an earth dam from the berme bank to the railroad embankment, immediately west of the railroad culvert, about 200 feet west of the brick farm house standing on the berme side of the canal. Openings to be cut in the berme bank in three places; each to be 100 feet in length, excavated to a depth of two feet below the water line of the canal.

All of the above named work to be done as may be directed by the Superintendent of Public Works.

Such masonry or slope and rip rap walls as may be necessary to protect the berme bank slopes of the canal from being washed and injured and the canal from being obstructed with bars washed into it from the railroad arch, box, and open culverts; and the pipe drains to be constructed as the Superintendent of Public Works may direct.

ERIE CANAL—DELAYS TO NAVIGATION.

During the season covered by this report the following delays to navigation have occurred on this canal.

November 8. At nine p. m. the steam canal boat "City of Milwaukee," loaded with grain and moving eastward, carried away the lower gates of the left lock of No. 14, the boat in sinking became wedged in the lock chamber and broke at the centre, allowing the grain to run into the chamber, rendering it necessary to remove it by means of hand scoops. The total delay to navigation was of but two hours duration, the right hand lock being used for traffic in both directions. The lock was cleared and damages repaired in about one week's time.

June 28. At eight a.m. several floor timbers in the trunk of the Yatesville aqueduct between locks 30 and 31, broke away. The necessary repairs were made the same day and navigation resumed on the morning of the twenty-ninth.

June 29. There was a delay to navigation of three hours duration caused by a boat loaded with coal sinking on the level, between locks No. 41 and No. 42.

Navigation was interrupted from July twenty-third, at midnight until the evening of July twenty-fifth, in order to repair the head of lock 44 at Ilion. This lock had long given trouble; it was considered unsafe to longer delay the repairs.

In consequence of a slight leak near the waste weir at Port Jackson on the thirty-first of August, the water was drawn down eighteen inches on this level and loaded boats stopped three hours. Light boats were not delayed.

There have been several short delays on the short levels between West Troy and Cohoes caused by sunken boats.

CHAMPLAIN CANAL AND GLENS FALLS FEEDER—DELAYS TO NAVIGATION.

The only delay to navigation on the Champlain canal was of about twenty-four hours duration, occurring September 23, 1886, caused by a sunken coal boat on the level between locks 14 and 15.

On the Glens Falls Feeder navigation was interrupted as follows:

October 14, 1885. A delay of twelve hours caused by a sunken boat on the level between locks No. 1 and No. 2. At Green's steam saw mill, from the morning of November ninth to November tenth, a delay was caused by a leakage through or under vertical wall, destroying about 150 cubic yards of embankment.

A sufficient height of water was maintained on the Champlain Canal. Navigation on the same being uninterrupted by this break.

CHAMPLAIN CANAL.

The disposition made during the past three years of the Extraordinary Improvement Fund has resulted in very materially improving this water-way, yet much work remains to be done which can only be accomplished by another special appropriation for this purpose. As will be seen by the statement submitted herewith the special appropriation under which the above work has been prosecuted is now very nearly exhausted, and, as the ordinary appropriation for the maintenance of this canal is not more than sufficient for keeping it in navigable order, and possibly preventing any retro-

grade movement in its condition, no further improvement can be hoped for without said special appropriation.

In making these improvements the objects had in view were as follows: The improvement in the capacity of the canal at points where the channel was very narrow and, therefore, difficult of navigation. The rectification of alignment at the worst bends, and the rebuilding of such structures as were required for its safe maintenance. I think these objects have been attained, as far as a judicious use of the money expended could attain them.

The general condition of this canal has been decidedly bettered during the past year, more especially as regards the tow-path on the northern end.

CHAMPLAIN CANAL — LOCKS.

The number, location and lifts of the locks remain as stated in my last report.

The following repairs have been made during the year :

Sloop lock, in the Troy dam, four new gates put in.

Side-cut locks, at Waterford, gates and breast walls repaired.

Weigh lock, at Waterford, mitre sill and two gates repaired.

Lock No. 3, south guard lock, two gates put in.

Lock No. 12, two gates put in.

The Following Repairs Should be Made.

Sloop-lock, Troy dam, walls need repointing. Walls are bulged in as reported last year.

No. 3. South guard-lock. I would renew my recommendation of last year relative to raising the coping at the head of this lock. The feeding-culvert around this lock should have a new timber cover.

No. 7. The coping on this lock should be raised one foot, the water now is but three inches below the top of coping.

No. 9. The work done on this lock two years ago, for stopping leakage through the east wall, was an entire success, and I would recommend that the west wall, which leaks badly, be treated in a similar manner. Also, that a cut-off be put in the tow-path at the head of the lock to check a long existing leak.

No. 21. There is some leakage through the berme wall; the same should be stripped and thoroughly puddled.

No. 23. The mitre-sill of this lock needs repairs, and, as the lock opens into the lake, it will be necessary to build a coffer dam and pump the water from the chamber.

Many of the locks on this canal have open joints, which should be refilled by grouting and repointing with Portland cement.

CHAMPLAIN CANAL AND GLENS FALLS FEEDER — DAMS.

There are eight dams on this canal and feeder, and are located and described in my report for the year ending September 30, 1884.

No. 1. Troy dam. The repairs to the apron, which were recommended in my last report, have been made.

No. 2. Cohoes dam. The buttresses built in front of this dam, one year ago, checked any further movement of the face of the structure, at points near the buttresses, but an additional bulge appearing in another place, an additional buttress, thirty feet long, was built during the year.

I would renew my recommendations of last year in relation to repairs and improvements of the dams on this canal and feeder.

CHAMPLAIN CANAL — AQUEDUCTS.

No. 1. At Schuylerville. The masonry of this structure is in the same condition as reported by me last year, and needs considerable repairs.

No. 2. Between locks No. 12 and No. 13. "Fort Miller Aqueduct." The masonry on the tow-path side has been very much injured by the action of frost and is bulged out, some of the stonework is displaced. Immediate repairs should be made on this structure.

No. 3. Above lock No. 14. "Moses Kill Aqueduct." The masonry should be repointed and the trunk repaired.

No. 4. "Fort Edward Aqueduct." The tow-path wing walls needs repairs. The masonry should be pointed and the trunk repaired.

CHAMPLAIN CANAL — WASTE-WEIRS AND SPILLWAYS.

My report of last year gave the number of waste-weirs and spillways, not including gates and spillways in aqueducts, as twenty-eight, since then the number has been reduced to twenty-seven; the one located at the head of lock No. 21, has been abandoned and closed, as recommended last year, by a vertical wall in cement.

The following repairs have been made during the year on these structures:

Waste-weir, north of Mechanicsville. New bulk-head with improved gates built and masonry repaired and grouted. The apron also was rebuilt and the stone filling at the foot of the same restored. While the repairs have improved the structure temporarily, I am still of the opinion that the same is unsafe and would renew my recommendation of last year, that the structure be rebuilt.

Waste-weir at Lansing's mill, Stillwater. The masonry has been repaired, new bulk-head with the improved lift gates built and earth filling on the canal side restored. Same recommendation as for the Mechanicsville waste-weir.

A new tow-path bridge has been built at "O'Brine's Spillway," between locks No. 15 and No. 16, about one mile north of Fort Edward.

The Following Repairs Should be Made.

Waste-weir below lock No. 8. Should have a new apron.

Waste-weir south of lock No. 10. Should have a new bulk-head and gates. I would renew my recommendation of last year as to cutting a channel in the rock bottom of the canal from lock No. 10 to this waste-weir, so as to drain the upper portion of this level.

Waste-weir at Dunham's basin. Repairs should be made to the piers and a fender inserted to prevent boats injuring the masonry.

The first waste-weir below Smith's basin is in bad condition, and should be rebuilt.

Waste-weir at Smith's basin. Should have a new improved bulk-head.

CHAMPLAIN CANAL — CULVERTS.

The number and description of culverts on this canal remain as described in my report of last year.

The box culvert, about one and one-quarter miles north of lock 8, is too small to carry the water in times of freshet. The opening is three feet square. I would recommend that the structure be rebuilt and enlarged.

Arch culvert, at Saulsbury's, between locks No. 9 and No. 10. No repairs have been made on this structure since my last report. I would renew the recommendation there made.

At lock No. 19 and just south of the same there is a box culvert running into and through the lock walls, parallel to the same, and discharging into the level north of the lock. This structure fails to drain the adjacent farm lands; the failure is due to the fact that the ditch leading to the culvert, and the farm lands, are so low that a sufficient grade cannot be obtained to secure rapid and thorough drainage.

The leak at "Walker's culvert," in Whitehall, heretofore reported, still exists.

The remainder of the culverts are in fair condition. Some of them need repairing.

I would renew my recommendation of last year that the diving culverts on this canal be pumped out and cleaned.

CHAMPLAIN CANAL — BRIDGES.

There has been no change in the number of bridges on this canal during the year.

The following have been rebuilt or repaired during the past year. The numbers of bridges correspond with those given on the map accompanying the State Engineer's report for the year ending September 30, 1881.

Between Locks No. 2 and No. 3.

Ontario street bridge, Cohoes. A new centre truss, Whipple cast-iron arch, is to be inserted in this bridge in order to have two roadways where now we have but one. The iron work has been furnished under contract with Adam Filsinger of Syracuse, N. Y., and delivered on the ground at a cost of \$392.39. The truss has not yet been placed in position.

Between Locks No. 6 and No. 7.

No. 15. Wooden farm, "Slade's." New wooden bent put in.

No. 16. Wooden farm, "Fisher's." New bridge built.

Between Locks No. 9 and No. 10.

No. 36. Wooden road at Stillwater, "Bull's." New bridge built.

No. 40. Wooden road, south of Bemis Heights. New bridge built.

No. 67. Wooden farm, "Strover's." New bridge built.

No. 72. Wooden change, first below lock No. 10. New bridge built.

Between Locks No. 14 and No. 15.

- No. 97. Wooden road, iron chords. Woodwork renewed.
- No. 98. Wooden road. New bridge built.
- No. 99. Wooden road. New bridge built.
- No. 102. Wooden farm. New bridge built.
- No. 106. Road and change at Fort Edward. Repaired.
- No. 107. Canal street, at Fort Edward. Repaired.

Between Locks No. 15 and No. 16.

- No. 119. Wooden farm. New bridge built.
- No. 123. Wooden farm, "Wait's." New bridge built.

Between Locks No. 20 and No. 21.

- No. 148. Boardman street, Whitehall, wooden with iron chords. The woodwork has been rebuilt.
- No. 149. Cooper wrought-iron, street. Woodwork renewed.

At the Foot of Lock No. 23.

- Cooper wrought-iron, street. Woodwork renewed.

CHAMPLAIN CANAL — BRIDGES.

The following bridges should be repaired :

Between Locks No. 7 and No. 8.

- No. 21. Road bridge. Should be rebuilt.

Between Locks No. 9 and No. 10.

- No. 46. Farm bridge, "Cheever's." Should be rebuilt.
- No. 49. Farm bridge, first south of Wilbur's Basin. Should be rebuilt.
- No. 51. Farm bridge, "Snyder's." Should be rebuilt.
- No. 55. Road bridge. Should be rebuilt.
- No. 59. Road bridge, "Holme's." Should be rebuilt.

Between Locks No. 13 and No. 14.

- No. 84. Farm bridge. Should be rebuilt.

Between Locks No. 15 and No. 16.

- No. 111. Farm bridge, first north of Glens Falls feeder, should be rebuilt.
- No. 115. Road bridge, Smith's Basin. Should be rebuilt.

Between Locks No. 20 and No. 21.

No. 138. Farm bridge, "Kibbie's." Should be rebuilt.

The recommendation as to painting bridges on the Erie canal applies with equal force to those on this canal.

CHAMPLAIN CANAL — BRIDGE ABUTMENTS.

There have been no new abutments built during the year. Both abutments of the Ontario street bridge at Cohoes have been lengthened to receive the new truss heretofore spoken of.

The following should be rebuilt or repaired.

Between Locks No. 6 and No. 7.

No. 19. Farm bridge, "McDonald's." Needs new berme abutment.

Between Locks No. 8 and No. 9.

No. 29. Best's farm bridge, at Pulp mill. The tow path abutment is badly cracked and the face stone have separated from the backing, I would recommend that the same be rebuilt.

Between Locks No. 9 and No. 10.

No. 40. Road bridge, second north of Stillwater. Needs a new berme abutment.

No. 41. Farm bridge, "Farman's." Needs new berme abutment.

No. 45. Farm bridge, "Hill's." Needs new berme abutment. The old abutment fell into the canal and was removed and the bridge is now supported on the berme end by a wooden bent.

No. 60. Farm bridge, "Dean's." Needs new berme abutment.

No. 68. Ferry street, Schuylerville. Needs new berme abutment.

Between Locks No. 13 and No. 14.

No. 97. Road bridge. The berme abutment should be rebuilt.

Between Locks No. 40 and No. 41.

No. 138. Farm bridge, "Kibbie's," second north of the first railroad bridge north of lock No. 20. The berme abutment of this bridge is falling into the canal and will need to be rebuilt the coming winter. I have made plans for rebuilding this abutment, setting the same back so as to obtain a width of canal of forty-four feet on the bottom, and estimate the cost of doing the work, includ-

ing a new superstructure, raising the two-path abutment and the necessary grading to the approaches, at \$1,706.70.

No. 142. Farm bridge, first south of Eastman's waste-weir. The berme abutment is sliding into the canal and will shortly need to be rebuilt.

No. 147. Farm bridge, "Tuft's," first bridge above second railroad bridge north of lock No. 20. The berme abutment of this bridge will probably fall into the canal this winter. I have made plans and estimate for rebuilding the same in a manner similar to No. 138, "Kibbie's," spoken of above. Estimated cost of same, \$1,884.45.

The railroad company having purchased the land adjacent to this bridge, and having no use for the structure, I am led to advise that the same be abandoned.

With the exception of those built within the past four years, most of the abutments need repointing.

CHAMPLAIN CANAL—VERTICAL WALLS, SLOPE WALLS AND DOCKING.

The only substantial improvements made during the year to the walls on this canal are the following: The slope wall built at "Woodchuck Bend," and the vertical wall on the berme side, three-fourths of a mile south of Fort Ann; both of which were done from the Extraordinary Repair Improvement Fund.

About 900 lineal feet of docking, located between lock No. 10 (south guard lock) and the river bridge, has been-renewed from two feet below the water line.

I would respectfully call your attention to the condition of vertical walls, slope walls and docking, and the recommendations thereon as stated in my report of last year.

CHAMPLAIN CANAL — PRISM AND BANKS.

Prism. The most important improvements to the prism of this canal are those elsewhere described, viz.: The dredging between Fort Ann and Fort Edward. The improvement at "Woodchuck Bend," and the improvement three-fourths of a mile south of Fort Ann. In addition to the above, extensive bars have been removed, by dredging, from the ponds above locks Nos. 3 and 10.

Banks. An attempt has been made to improve the tow-path banks on sections No. 1 and No. 2, by means of road scrapers, but the banks were so low that sufficient material could not be found to enable the scraper to work to an advantage.

On the greater part of section No. 3, and a portion of section No. 2, the tow-path is in a fairly satisfactory condition; but on the whole of section No. 1; and a portion of section No. 2, it is dangerously low, and immediate steps should be taken to raise it.

I would renew my recommendations of last year as to restoring the inner angle of the tow-path, in order that the banks may be restored to the proper grade and width.

EXTRAORDINARY REPAIRS — CHAMPLAIN CANAL.

Special Appropriations.

By act chapter 330, Laws of 1886, the sum of \$6,000 was appropriated by the Legislature for the protection of the eastern bank of the Hudson river, at Lansingburgh, etc.

Plans and estimates have been prepared, and the contract awarded to J. B. Marshall & Co., of New Baltimore. By the terms of the contract the work is to be completed by January 1, 1887.

By act chapter 336, Laws of 1886, the sum of \$5,000 was appropriated for a lift bridge in the village of Mechanicsville. The preliminary survey for this work has been made, and it is expected that the bridge will be completed by opening of navigation next spring.

By act chapter 554, Laws of 1886, the sum of \$33,000 was appropriated for the construction of an iron highway and towing path bridge over the Mohawk river, between the city of Cohoes and the town of Waterford.

The contract was awarded to O. F. Hilt, of Greenbush, N. Y., This bridge will be built during the coming winter.

EXTRAORDINARY REPAIRS — CHAMPLAIN CANAL IMPROVEMENT.

Under act chapter 97, Laws of 1882, the sum of \$199,877.80, being the unexpended balance of the sum of \$500,000 appropriated by act chapter 399, Laws of 1874, for the improvement of the Champlain Canal, was appropriated to be expended under the direction of the Canal Board, for continuing the improvement of the Champlain Canal and Glens Falls feeder.

By act chapter 301, Laws of 1884, and act chapter 441, Laws of 1886, the unexpended balance of this fund with the accrued interest thereon have been reappropriated for the same purpose.

My report for the year ending September 30, 1885, gives in detail a statement of the sums set apart by the Canal Board for the various pieces of work authorized to that date; the said list closing with No. 59. Since then the following amounts have been set aside by a resolution of the said board :

No. 60. For improving the tow-path between lock No. 3 and the river bridge, Cohoes, \$7,539.50.

This improvement contemplates the removal of the old and decayed docking (about 530 lineal feet in length), on the tow-path side between lock No. 3 (South Guard Lock), and the highway bridge over the Mohawk river, and replacing it with a vertical wall in cement. The new wall to begin at a point nine feet north of the upper recess angle of lock No. 3, and to end at the vertical wall now standing at the north end of the old docking. Length of the new wall to be about 530 feet. The work to be protected by a coffer-dam built in the pond and connecting with the east side of the guard lock so that the work can be drained through the said lock and pumping be avoided. The alignment of the present inner angle to be improved by cutting off some of the present bends and angles.

No. 61. For the improvement at the Wilcox or Sarle's farm bridge at Coveville, the sum of \$2,666.38.

This improvement contemplates the building of 300 lineal feet of slope wall on the tow-path side of the canal, from a point two and one-half chains north of the centre of the arch culvert below the bridge and running north; also the tearing down and rebuilding the berme abutment of the bridge, setting the same back so as to obtain a width of forty-four feet on the bottom of the canal; also the necessary rock and earth excavation on the berme side to obtain the desired width, raising and lengthening the approaches and constructing a new wooden whipple truss bridge of seventy feet ten inches clear span and twelve feet roadway.

This work is necessary in order to gain the full benefit of the work heretofore done just north of the bridge. Several years ago the canal was widened south of this point, and immediately on the north lies the extensive work done by Chester Ray, contractor in 1884 and 1885 (No. 6 of the list of extraordinary repair improvements), where we have obtained the standard width of forty-four feet on the bottom of the canal, while this short piece of canal lying

between the two improvements has a width in places of only thirty feet.

No. 62. For improving the berme bank, three-quarters of a mile south of Fort Ann, the sum of \$4,175.63.

This improvement consists of the widening of the canal on the berme side by excavation, so as to obtain the width of forty-four feet on the bottom. The building of a vertical wall in cement and strengthening the bank by means of embankment. Station O is on the inner angle of the tow-path, two chains south of the centre of the culvert. Stations run north. The prism excavation extends from station O+50 to station 8+17. The embankment extends from station O to station 8+17. The vertical wall extends from station 1 to a point 345 feet north of the same, with a twist wall on each end of the same of thirty-three feet in length and to connect with the present slope wall.

Of the above the Superintendent of Public Works has completed No. 62 at a cost of \$4,542.69.

No work has yet been done on Nos. 60 and 61 of the work noted in my last report as being partially completed.

No. 32 has been completed during the year by the Superintendent of Public Work. This work is at "Woodchuck Bend," and the cost thereof was \$2,254.40.

No. 45, at Lauder's culvert, has not been fully completed as contemplated, the full amount of embankment not having been put on the tow-path side. The amount expended to date has been \$4,286.66. The amount set aside by the Canal Board, engineering not included, was \$4,298.01.

No. 30. Raising abutments and approaches. No work has been done this year. The total amount expended to date is \$1,756.62. The amount set aside by the Canal Board, engineering not included, is \$2,489.15.

No. 58. Dredging between Fort Ann and Fort Edward. This work is not yet completed, but has been prosecuted with vigor and will be continued up to the close of navigation. It has been productive of very good results, and in an economical manner has greatly increased the ease of navigation of that portion of the canal on which the work has been done. The amount expended to date is \$1,767.38. Amount set aside by Canal Board, \$5,000. The original amount set aside for this work was \$6,000, but by resolution of the Canal Board January 27, 1886, the amount was reduced to \$5,000.

No. 40. Improving the berme bank at lock No. 8. No work has yet been done here.

No. 42. Strengthening the tow-path at Wilburs' basin.

No. 43. Strengthening the tow-path between bridges Nos. 79 and 80. No work has yet been done on Nos. 42 and 43.

I hereto attach a statement showing the condition of the Champlain Canal Improvement Fund up to September 30, 1886.

CHAMPLAIN CANAL IMPROVEMENT.

ACT CHAPTER 441, LAWS OF 1886.

Present Condition of Fund.

Amount of appropriation by Legislature, with interest to July 1, 1885.....	\$210, 342 61
Interest from July 1, 1885, to July 1, 1886.....	780 70

<i>Cr.</i>	\$211, 123 31
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Amounts set aside by resolution of the Canal Board. (See last report)...	\$214,892 77
Add amounts set aside by resolution of the Canal Board, since last report. (See below).....	15,606 22

\$230,498 99

Deduct amount rescinded by Canal Board, January 27, 1886.....	1,000 00
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\$229,498 99

From this deduct excess of amounts set aside by Canal Board over the amounts actually expended for completed work, viz.,

On work done by contract.....	\$18,044 02
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Superintendent of Public Works.....	1,677 47
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19,721 49

Net amount set aside by Canal Board.....	209,777 50
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Balance in treasury not yet set aside by Canal Board,	\$1, 345 81
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Deduct amount necessary to complete work three-quarters of a mile south of Fort Ann.....	814 45
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Amount available for further improvements.....	\$531 36
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Of the above \$209,777.50, the total net amount set aside by the Canal Board, there remains the following unexpended balances:

On Work Partially Completed.

Raising abutments, etc., of two bridges, thirty of last report	\$732 53
Dredging between Fort Ann and Fort Edward.....	3, 232 62

Completed, but not Paid for.

Improving berme bank at Smith's Basin.....	175 00
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On Work not yet Commenced.

Improving berme bank at lock No. 8.....	592 60
Strengthening tow-path bank at Wilbur's basin.....	478 40
Strengthening tow-path between bridges No. 79 and No. 80.....	670 50
Improving tow-path between lock No. 3 and river, bridge, at Cohoes.....	7,539 50
Improving at the Wilcox bridge, Coveville.....	2,666 38

Total unexpended balances in treasury.....	\$16,087 53
Total amount not yet set aside by Canal Board.....	1, 345 81

Total amount in treasury, September 30, 1886.. \$17, 433 34

GLENS FALLS FEEDER.

This feeder has been greatly improved during the past few years. During the past year many leaks through the rock bottom and side walls have been stopped, though there still remains a large wasteage of water, and in some places injury is being done to the adjacent lands by leakage. Much of this feeder is built through rock filled with seams, the leakage through which has been large, and costly attempts have been made to stop the same. Although the present leakage is less than ever before, much still remains and renders it necessary to do a large amount of work to stop the same.

The number and location of all structures on this feeder remain as given in my last report.

New mitre sills have been put in locks No. 5, No. 6 and No. 8. New bottoms in locks No. 7 and No. 9. The bottom of Lock No. 13 has been concreted and general repairs made to locks No. 3, No. 5, No. 6, No. 7, No. 8, No. 9 and No. 12.

The head of lock No. 4, which had settled (see last report) has been taken down and rebuilt. The lock has been lengthened and the quoin stones replaced by others cut on the enlarged plan.

Timber has been ordered to rebuild the sluices around the five combined locks, work on the same will be commenced at the close of navigation.

A large bar which had formed at the head of the guard lock, and which interfered with the passage of water and boats through the lock, has been removed during the past season. This was a difficult piece of work, due to the fact that a dredge could not be used, none could be found small enough to pass through the feeder locks.

South of "Green's bridge" the feeder passes through a sand cut; extensive leakage has existed here for years; during the past year the bottom and sides of a portion of this cut have been covered with a layer of puddle nine inches in thickness and has cut off much of the leakage.

Three new foot-bridges have been built at the combined locks.

Repairs have been made to the first road bridge west of lock No. 13 and to the "Monty" and "Haviland" farm bridges.

ENGINEERING DEPARTMENT.

This division has for the past fiscal year been in charge of John R. Kaley, Division Engineer, and Chapman L. Johnson, Acting Resident Engineer, from October 1, 1885, to August 8, 1886, and Chapman L. Johnson, Resident Engineer from October 9, 1886, to September 30, 1886. The work of the department during the year has been as follows:

Attending to general routine of office work, making surveys, plans and preliminary estimates for rebuilding waste-weir east of Port Jackson, drain through cemetery at Cohoes, repairs to Schoharie creek dam; new iron bridge at Franklin street, Fultonville; new abutment and superstructure first bridge east Canajoharie; rebuilding waste-weir a half a mile west of lock No. 33; vertical wall at head of lock No. 38; vertical wall on Little Falls feeder; rebuilding Little Falls dam, all on the Erie Canal; and Lansingburgh dyke; repairs to Ontario street bridge, Cohoes; improvement north of lock No. 3, Cohoes; bridge over Mohawk river at Cohoes; lift bridge on Railroad street, Mechanicsville;

improvement at Wilcox Bridge, improvement three-fourths mile south of Fort Ann; for rebuilding two (2) berme bridge abutments and two (2) superstructures on the Whitehall level, all on the Champlain canal.

Making surveys, maps and reports on alleged nuisance existing near McDonald's hotel near lock No. 2, Erie canal; alleged nuisance at Mill creek, Schenectady; condition of Cohoes dam, on proposed new location of change bridge at Fort Edward, and searching old maps and records and making report on subject of liability of State to maintain bridge across feeder at Rexford Flats; staking out and supervising work at suspension foot-bridge in Albany; iron foot-bridge in West Troy; new iron bridge at Fultonville; new abutment and bridge at Canajoharie; vertical wall at head of lock No. 38; vertical wall on Little Falls feeder, and iron bridge at Herkimer, on the Erie canal; improvement at Ontario street, Cohoes; improvement at Woodchuck Bend; improvement three fourths mile south of Fort Ann, all on the Champlain canal, and rebuilding head of lock No. 4, on the Glens Falls feeder. The preparation of final accounts for building bridges at Lumber District, Albany; Middle street, West Troy; Franklin street, Fultonville, and road bridge at Herkimer.

Making survey and topographical map of grounds at executive mansion in the city of Albany, staking out supervising and preparing final estimates of excavation for foundations and cellar of mansion, and giving needed points for location of walls, etc.

Making surveys, profiles, etc., of proposed improvement of abandoned canal at Rome.

Making surveys and maps, and giving testimony before the Board of Claims in defense of twenty three suits against the State.

The preparation of a map of the Albany basin, showing the several improvements therein from 1823 to 1885.

Rearranging, binding and indexing the maps, plans, etc., on file in this office.

A statement of the engineering expenses is hereto annexed, showing in detail the names of persons employed, time of service and compensation of each.

STATEMENT showing names, rank, number of days and compensation of Engineers employed on the Eastern Division of the New York State Canals, together with incidental expenses during the fiscal year ending September 30, 1886.

ORDINARY REPAIRS.

Erie Canal.

NAME.	Rank.	Salary or Travel.	No. of days.	Rate.	Total amounts.
John R. Kaley	Division engineer	Salary .....	.....	\$2,400 00	\$1,600 00
John R. Kaley	Division engineer	Travel .....	.....	.....	68 59
Chapman L. Johnson	Resident engineer	Salary .....	.....	2,000 00	200 00
Chapman L. Johnson	Resident engineer	Travel .....	.....	.....	20 68
Chapman L. Johnson	Assistant engineer .....	.....	267	5 00	1,335 00
Chapman L. Johnson	Assistant engineer	Travel .....	.....	.....	197 97
Oscar F. Balston	Assistant engineer .....	.....	50	5 00	250 00
Oscar F. Balston	Assistant engineer	Travel .....	.....	.....	7 44
James P. Campbell	Assistant engineer .....	.....	108	5 00	515 00
James P. Campbell	Assistant engineer	Travel .....	.....	.....	16 10
John P. Kelly	Assistant engineer .....	.....	60½	5 00	302 50
John P. Kelly	Assistant engineer	Travel .....	.....	.....	18 88
Edward E. Sweet	Leveler .....	.....	86	4 50	387 00.
Edward E. Sweet	Leveler	Travel .....	.....	.....	25 20
Martin Schenck	Leveler .....	.....	222	4 50	999 00
Martin Schenck	Leveler	Travel .....	.....	.....	143 64
Charles H. Whitbeck	Rodman .....	.....	60	3 50	210 00
Charles H. Whitbeck	Chainman .....	.....	253	2 50	632 50
Charles H. Whitbeck	Chainman	Travel .....	.....	.....	34 17
Fletcher W. Battershall	Chainman .....	.....	29½	2 50	73 75
Fletcher W. Battershall	Chainman	Travel .....	.....	.....	14 21
Charles M. Pepson	Chainman .....	.....	23	2 50	57 50
Charles M. Pepson	Chainman	Travel .....	.....	.....	26 51
John H. Jones	Chainman .....	.....	2	2 50	5 00
John H. Jones	Chainman	Travel .....	.....	.....	5 69
<i>Incidentals.</i>					\$7, 146 03
Clerk hire and labor .....	.....	.....	.....	\$502 50	.....
Stationery .....	.....	.....	.....	209 33	.....
Postage, telegraph and telephone .....	.....	.....	.....	84 65	.....
Miscellaneous .....	.....	.....	.....	275 09	.....
					1, 071 57
Total for Erie canal					\$8, 217 60

Champlain Canal.

John R. Kaley	Division engineer	Salary .....	.....	\$2 400 00	\$800 00
John R. Kaley	Division engineer	Travel .....	.....	.....	77 05
Chapman L. Johnson	Resident engineer	Salary .....	.....	2,000 00	90 41
Chapman L. Johnson	Resident engineer	Travel .....	.....	.....	19 75
Total for Champlain canal					\$987 21

EXTRAORDINARY REPAIRS.

Champlain Canal.

NAME.	Rank.	Travel.	No. of days.	Rate.	Total amounts.
James P. Campbell.....	Assistant engineer	Travel ..	50	\$5 00	\$250 00
James P. Campbell.....	Assistant engineer	Travel ..	44	4 50	6 70
George I. Bailey.....	Leveler	Travel ..	70	3 50	198 00
George I. Bailey.....	Leveler	Travel ..	70	2 50	6 54
Charles H. Barber.....	Rodman	Travel ..	70	2 50	245 00
Charles H. Barber.....	Rodman	Travel ..	70	2 50	58 24
James Ryan, Jr.....	Chainman	Travel ..	70	2 50	175 00
James Ryan, Jr.....	Chainman	Travel ..	70	2 50	40 30
<i>Incidentals.</i>					\$979 78
Clerk hire and labor..				\$200 00	
Miscellaneous.....				47 88	
					247 38
Total extraordinary repairs Champlain canal					\$1,227 16

The above statements are summarized as follows :

SUMMARY OF STATEMENTS.

Expended for ordinary repairs, Erie canal, from October 1, 1885, to October 1, 1886.	\$7,146 03
Expended for ordinary repairs, Champlain canal, from October 1, 1885, to October 1, 1886.....	987 21
Expended for incidentals, ordinary repairs, Erie and Champlain canals, from October 1, 1885, to October 1, 1886.....	1,071 57
Expended for extraordinary repairs, Champlain canal, from October 1, 1885, to October 1, 1886.....	979 78
Expended for incidentals, extraordinary repairs, Champlain canal, from October 1, 1885, to October 1, 1886.....	247 38
Total	<u>\$10,431 97</u>

MIDDLE DIVISION.

ANNUAL REPORT OF DENISON RICHMOND, DIVISION ENGINEER, FOR
THE FISCAL YEAR ENDING SEPTEMBER 30, 1886.

SYRACUSE, N. Y., *October 1, 1886.*

HON. ELNATHAN SWEET,

State Engineer and Surveyor :

SIR.— Under instructions contained in chapter 162, Laws of 1862, prescribing the duties of engineers, I have the honor to report the expenses of the engineer department for the fiscal year ending September 30, 1886; together with statements, showing present condition of the canals of this division and repairs recommended.

NAVIGATION, ETC.

The canals opened May first, eleven days earlier than the year previous. The reservoirs never contained a better supply of water, all being nearly full, including the North Woods' reservoirs. The dry weather during the summer necessitated a heavy draught on the latter, which were constantly drawn upon, commencing as early as May twenty-fourth and, notwithstanding all precautions to save water, the supply came near being exhausted, but the heavy rains in the latter part of September prevented this, and a good supply seems now assured for the balance of the season. An appropriation should be made this winter for the construction of a reservoir at Forestport, as recommended in previous reports. There seems to be small prospects of diverting many more of the North Woods lakes to advantage, and without consuming too much time to be of any use for immediate relief, should the contingency arise, although it would be attempted. From some investigations that have been made, it is thought that Jock's lake could be turned into South lake reservoir, but it is so distant that much loss of water would result and it is not at all certain that it is feasible as no survey or estimate has been made. Another plan suggested is the construction of a channel from the Bisby lakes outlet along the side of the intervening mountain to

the head of the ravine that leads to Woodhull reservoir. An instrumental survey has been made and the cutting found to be mostly rock. The expense and time consumed in forming the channel would be considerable, and a loss of water through the seams in the rock would naturally follow. At best, these improvements will not afford immediate relief if the North Woods reservoirs should suddenly become completely exhausted, from an extreme drouth following a season when the reservoirs failed to fill, and, in my opinion, the early construction of the Forestport reservoir is an absolute necessity to maintain uninterrupted navigation from Syracuse to Little Falls. A flow line for the reservoir has been established, and a map of the same placed on file. Much preliminary work was done in 1884, which is given in detail in a previous report. The engineer's estimated cost, exclusive of land damages and clearing the flow ground, was \$65,000. An appropriation of \$20,000, chapter 452, Laws of 1883, was made and about \$15,000 of this amount expended under the direction of the Superintendent of Public Works. When completed, this reservoir will be virtually an enlargement of the pond at Forestport, where all the waters of the North Woods lakes and natural reservoirs are received before entering the feeder, but which is so small as to be of little advantage as a storage basin or to retain the water that wastes over the dam after every heavy rain that causes a rise in the Black river. No doubt the new reservoir could be filled several times each year from the surplus flow.

But few interruptions have occurred on any of the canals, the most serious being on the Erie, August eighth, caused by the undermining of lock No. 47, which interfered with, and finally prevented, the filling of the lock chambers. A coffer-dam was at once constructed at the head of the lock to retain the waters of the Rome level, and the levels below drawn off and thoroughly drained with steam pumps. It was found that the floor of the culvert had been forced up, and a large hole had been formed from one lock to the other. The first cause, no doubt, was the displacement of the lining of the berme lock by force of the water discharged under the tumble gate, but which was examined just before the opening and showed no signs of failure. Concreting was as thoroughly done as possible, and the floor of the culvert replaced and secured. Complete and permanent repairs require a section of the culvert to

be taken up and replaced, by excavating, from the top of the filling between the locks, the bench walls are displaced and have settled from the undermining. Navigation was interrupted about thirty-six hours. No time was lost in making the repairs, and the delayed boatmen seem well satisfied with the progress of the work, which was finished sooner than they anticipated. This was the only detention on this division of the Erie canal of any importance.

Notwithstanding the early opening, more than the ordinary amount of spring cleaning was done, the most important places receiving attention. Bars that were washed in from the small streams that empty into the prism were removed, and, west of Syracuse, no complaints of boats grounding have been reported, even on the Jordan level, which, from the existence of several miles of the original bench walls, has been particularly liable to detentions of this character. Low water and strong westerly winds have caused some trouble on the west end of the Rome level, especially between Headsons and Butternut creek aqueduct. The bottom at this point should be lowered.

As has been repeatedly recommended in former reports, a thorough and general cleaning out of the prism should be made and liberal appropriation provided for this purpose. The agitation of the material in the center of the prism by the wheels of loaded steam canal boats, has a tendency to deepen the same below the established canal bottom, and the deposits accumulate at the foot of the slope walls, and in the greatest quantities on the berme side, where there is the least current. The material so stirred up along the navigated channel, being held in solution, is also carried along to the still waters of the basins or wide waters and deposited; such basins have been cleaned out repeatedly for the purposes of winding boats, or where declared nuisances by village authorities, and in a surprising short space of time the sediment is found to have accumulated as badly as ever. Such being the observed fact, it has suggested a plan for deepening the canals, where practicable, by dredging a channel or catch basin, on the berme side, far enough away from the toe of the wall to prevent undermining. The greater portion of the sediment, across the entire prism, would then gradually find this pool, leaving a lowered and clean prism. The excavation along the line of this channel would be so deep that it would not be necessary to skim over a large surface to secure a

dipper full, but could be dredged to advantage and thrown over the berme bank, while the basin could be cleaned out in the same manner when required. The dredge could be located at all times where it would interfere as little as possible with moving boats. Although these excavations could not be made along rock bottoms, over the culverts, or in too close proximity to certain structures, it would, nevertheless, cover a good many miles of the canal, and be, in my opinion, a cheap and practicable manner of deepening the prism at a time when such work could not be done in any other manner.

About ten miles of the original bench walls still exist on this division, principally on the Jordan and Rome levels. One-half being on the berme side of the Jordan level. These should be replaced with slope walls. The towing-path and the banks generally show marked improvement over their condition a year ago. This is due mainly to the constant work of the gravel scows, which are of such large capacity that every load improves many feet of the tow-path. The road-scraper has also been used to great advantage in forming the bank in proper shape to shed the water. The State dredge has been at work principally on the Cayuga and Seneca and Oswego canals. Many general repairs have been made to masonry and walls.

REPORT OF WORK DONE DURING THE FISCAL YEAR ENDING
SEPTEMBER 30TH, 1886.

Aqueducts.

Chittenango creek. One span replanked and masonry repointed.

Limestone creek. Masonry repointed.

Butternut creek. Masonry repaired and repointed.

Seneca river. Four spans entirely rewooded and timber delivered for four more spans.

Bridges — Superstructures Built on Change of Plan.

The wooden bridges No. 17 (Pratt street, Utica), and No. 63 (Durhamville east road bridge), have been replaced with iron truss bridges.

Bridge Superstructures Rebuilt on Former Plans.

No. 29. Brainard's farm.

No. 30. Parkhurst's farm.

No. 43. Barne's road.

No. 44. Brainard's road.

No. 45. Armstrong's farm.

No. 46. Herrig's road.

No. 53. Stacey's basin road.

No. 65. Bennett's road (Durhamville.)

No. 66. Span over highway at Schoolhammer's road bridge.

No. 67. Lenox basin road, road bridge below bulk-head, Oneida feeder; road bridge at Cherry street, Oneida; Oneida feeder, South bay bridge, Oneida lake canal; road bridge at Jamesville; two bridges at DeRuyter reservoir; bridge over State ditch at Memphis; and

No. 119. Beaver street, Jordan.

Bridges Repaired.

No. 2. Starch factory, Utica, east roadway, replanked.

No. 3½. Across basin, on berme at Broad street, Utica, entirely rewooded.

No. 9. Hotel street, lift bridge, Utica, replanked.

No. 12. Foot bridge, Broadway, Utica, new steps.

No. 13. Foot bridge, Cornelia street, Utica, new steps.

No. 14. Whitesboro street, Utica, replanked.

No. 16. Schuyler street, Utica, replanked.

No. 21. Clinton street, Whitesboro, entirely rewooded.

No. 24. Watkins street, Whitesboro, replanked.

Tow-path bridge, over old feeder at Rome. General repairs.

No. 42. Doxtater avenue, Rome, replanked.

No. 64. Main street, Durhamville, entirely rewooded.

No. 66. Schoolhammer's road bridge, replanked.

No. 84. Change bridge, Limestone feeder, replanked.

No. 88. Thompson's landing road, replanked.

No. 90. Beach street, Syracuse, general repairs.

No. 100. Salina street swing bridge, Syracuse, new plank and joists.

No. 102. Franklin street foot bridge, Syracuse, new plank and joists.

No. 106. Bridge street, Geddes, new plank and joists.

No. 108. Blast furnace road, Geddes, replanked and some new joists put in.

No. 135. Main street, Port Byron, west sidewalks replanked.

No. 136. Owasco street, Port Byron, entirely rewooded.

Bulk-Heads.

Bulk-head at Chittenango. New cap and general repairs.

Culverts.

Nail creek culvert at Utica, has had general repairs.

First culvert west of bridge No. 48 (Tuttle's road), has had general repairs.

Docking and Vertical Wall, Rebuilt.

About 250 lineal feet on berme at head of lock 46. About 700 lineal feet west of Brutus street, Weedsport, and on berme between High and Salt streets, Montezuma, has been rebuilt.

Dams.

Nine mile creek feeder. A new spillway and plank apron has been put in.

Gate-House.

The gate house at Oriskany dam has been put in good repair.

Locks.

No. 47. Three new gates and eight new valves.

No. 48. Three new gates and eight new valves and new piers at head.

No. 49. Four new gates and four new valves.

No. 50. Two new valves and some plank on gates.

No. 51. The bottom has been replanked and floor binders inserted.

Masonry.

The masonry has been repointed where needed on section No. 6 (from Canastota to Nine Mile creek [Camillus] feeder).

Spillways.

General repairs were made to spillways on berme, at Montezuma.

Towing-path and Berme Bank.

The tow-path has been raised with gravel on the greater part of the division and both tow-path and berme banks strengthened in weak points. Both are now in good condition, although the raising of the tow-path should be completed.

Breaks and Leaks.

A troublesome leak occurred last fall in the New York Central and Hudson River Railroad tunnel, just east of lock No. 47, and was repeatedly checked, but suddenly increased to such an extent that it became necessary to build a bank into the prism, requiring several hundred yards of gravel before it was completely controlled, and necessitated the closing up of the berme lock the fore part of November. Just before the opening of the canal, the material was removed and the hole found to be at the angle formed by the junction of the parapet and bench walls, where spalls had gathered at the time the structure was built. These were dug out as low as practicable, and then grouted and filled with concrete and puddled clay. The top of the tunnel was also cleaned off and thoroughly covered with Portland cement. The tunnel is now as free from leakage as could be expected; more so than it has been for many years.

A break occurred through the Port Byron feeder, and was repaired this spring, it having occurred from a freshet during the winter.

CAYUGA AND SENACA CANALS.

Structures Rebuilt — Docking.

At lock No. 9, on both sides.
 Between tow-path bridge and lock No. 8.
 At lock No. 8, on both sides.
 At lock No. 7, above and below.
 At lock No. 4, above and below.
 Between Bridge street and railroad, Seneca Falls.
 Between Gorham bridge and tow-path, over river.
 Between locks Nos. 1 and 2.
 At the head of lock No. 1.

State Shop.

The State shop, at Seneca Falls, was burned July 4, 1886. It is now rebuilt.

Structures Repaired — Bridges.

Swing bridge over lock No. 10. New floor.
 Tow-path bridge over factory flume, Seneca Falls. General repairs.

Bridge No. 17, on short level, at Waterloo. New floor and coping and repainted.

Bridge No. 19, Locust street, Waterloo. General repairs.

Bridge No. 22, soap mine, Geneva. General repairs.

Bridge No. 25. Lake street Geneva, south roadway. Replanked.

Dams.

Bemis' dam. General repairs.

Demont's dam. General repairs.

Distillery dam. New flush boards.

Locks.

No. 10. General repairs.

No. 8. Slight repairs.

No. 7. New coping.

No. 5. One new balance beam.

No. 4. Two new upper gates.

No. 3. Two new upper gates; lower gates repaired, sides pointed, new mitre sills and floor, with cement and grout.

Side lock No. 1 into mill-race. General repairs.

Receivers.

Receivers at Castle creek, Geneva. General repairs.

Dredging.

The State dredge has been employed on this canal the past season more particularly on the Cayuga level; also dredging in the harbors of Geneva and Cayuga and other points on the division where needed.

Towing-path.

The towing-path has been graveled where needed and the pile docking at Geneva has had slight repairs.

OSWEGO CANAL.

Structures Rebuilt—Bridges.

Wooden truss, forming approach to lock No. 11.

Foot bridge on Liverpool side-cut, replaced by a swing.

Avery bridge, north side-cut, Salina.

Swing bridge at Oak Orchard. (Oneida river improvement).

No. 20. Pratt street, Fulton.

Sluices or Tow-path Bridges.

Upper part of sluice No. 6.

Sluices No. 29½, 30, 33, 40 and 41.

Bulk-Heads.

Bridge over bulk-head, near lock No. 5. Rebuilt.

Bulk-head, at each side of Fulton dam (at box factory), rebuilt.

Docking.

About 300 lineal feet, at Gales' storehouse, Liverpool.

About 500 lineal feet, at Belgium bridge.

About 500 lineal feet, at Three River Point, south from bridge.

Dams.

Phoenix dam, 163 lineal feet. New apron.

Van Buren dam, 292 lineal feet. New apron.

These are crib aprons filled with stone, and have been expensive structures, made necessary by the wearing away of the soft rock below.

Structures Repaired — Bridges.

No 1. James street, Syracuse, sidewalk replanked, new joists and coping.

No. 2. Willow street, Syracuse, new coping and sidewalks repaired.

No. 7½. Bridge at Park street, over south side-cut, Salina, replanked.

Float-bridge, near Baldwinsville, part of timbers renewed and replanked.

Bridge at Jack's Reefs. General repairs.

Dams.

Dam at Baldwinsville. Temporary repairs.

Locks.

Lock No. 7. Two new upper gates and bottom repaired.

Steamboat lock, at Oak Orchard. New upper gates.

BLACK RIVER CANAL.*Repairs Made.*

Considerable ice-breaking was necessary before the close of navigation last year on this canal to enable the boats to reach their

destination. Before the opening of navigation, sediment and bars were taken out where found troublesome. Large quantities of gravel and slate had been washed in by the overflow of the stream at Hall's culvert and were removed. Similar trouble at Lansing Kill feeder, near lock No. 23, was obviated by turning the channel of the stream. Heavy sand bars at Locks 102 and 109 were removed. The towing-paths, especially around the locks, has been raised and strengthened with slate and gravel. Sink holes in the bottom of the canal have been filled with concrete. Several small breaks have occurred on this canal and at Delta feeder, detaining boats but a few hours. No other detentions have been experienced. The dredge force has been constantly at work on section No. 2, and all sand-bars and obstructions have been promptly removed. Brush has been cut along the towing-path between Lyons Falls and Booneville.

Locks.

All the locks were thoroughly examined and repaired. Locks Nos. 34, 35, 36, 47, 48, 49, and fourteen others on section No. 2, were repointed with cement. New mitre-sills were inserted at locks Nos. 13, 34 and 50, and the bottoms of locks Nos. 99 to 107, inclusive, were entirely replanked, and others repaired. The jaws of Nos. 1, 29, 37, 48 and 60 having become crowded over by the action of the frost, were dressed off. A large number of sluices have been repaired, some of them requiring considerable labor and expense, as at lock No. 64, where 250 lineal feet of stone docking was built, and at eighty-one and eighty-seven, which were concreted to prevent loss of water through the crevices of the locks. Over fifty new gates have been rebuilt and seventy new balance-beams inserted. A coffer dam was built above guard-lock No. 103, the gates being unsafe.

One thousand five hundred lineal feet of slope-wall was built at the north end of Sugar river aqueduct to protect the bank of the canal from the wash of the river. Also 500 feet along the tow-path at Lansing Kill creek, and 150 feet of docking below lock No. 2. Timber for facing ten locks and for about forty lock-gates is delivered.

Dams.

Delta dam across the Mohawk river at the head of the Delta feeder, had given much trouble in former years, being an old

wooden structure, and the river being subject to heavy freshets, with much floating ice running in the spring of the year, it had been difficult to anchor an apron properly. In the fall of 1884 the apron was rebuilt on a new plan, being anchored to 100 piles and the dam proper repaired. No further trouble was anticipated, but the extraordinary freshet of January, 5, 1886, overflowed the banks between the mill and the south abutment, resulting in a bad wash-out, carrying away the abutment, docking and about 100 feet of the dam clean to the rock, ten feet below the surface of the river. The pile apron, however, received little damage and prevented the entire structure from being carried away. As it was necessary to turn the water over the undisturbed portion of the dam, a temporary pile dam was commenced, but, before completion, another freshet damaged it so badly that a crib dam filled with stone was resorted to, commencing May fourteenth, which accomplished the purpose of maintaining navigation and enabling the work of permanent repairs to be commenced. Cribs filled with stone for a new foundation were sunk and the entire work completed in the three months time, in a substantial manner, without further trouble, including a new crib docking 125 feet long and bulk-head for mill, requiring, in all, about 124,000 feet of lumber.

Repairs were made to dams at Carthage, Lyons Falls and Old Forge.

Aqueducts.

The roadway to Stringer's creek aqueduct has been repaired with entire new woodwork.

Waste Weirs and Culverts.

The woodwork of the Booneville and Forest Port waste weirs was renewed. The culverts at North Western, Westernville and Hall's have been cleaned. The latter is particularly troublesome and this season became stopped up, the water overflowing and damaging the canal banks. Very heavy rains cause the walled channel, 600 feet in length, to fill up with slate and debris, washed from the adjacent hills.

Bridges.

The wooden bridges known as Courtney, Owen, Floyd, Davis, Waldo and Thomas street, and three on section No. 2, have been rebuilt. One new iron bridge with stone abutments has been

built at Hawkinsville, and eight wooden abutments renewed. The stone abutment at Kendall's bridge fell into the canal and was rebuilt. Many of the bridges over the canals and the long river bridges with swings attached, have had more or less repairs, some quite extensive.

ERIE CANAL.

Repairs Needed for the Fiscal Year.—Aqueducts.

Saquoit creek. New sides and replanking.

Cowassalon creek. New sides. (Timber delivered for partial renewal.)

Limestone creek. New caps.

Centerport. New tow-path bridge (entire). Masonry at each abutment leaks. Should be puddled in rear and repointed.

Port Byron. Tow-path needs replanking, and berme, west abutment leaks. Should be puddled and pointed.

Seneca river. Fourteen spans need new trunk. At least four new spans should be rebuilt each year until completed.

Bridges to be Rebuilt.

No. 27. Christian's farm. New superstructure.

Farm bridge over Oriskany feeder. New superstructure.

No. 31. Kirley's farm. New superstructure.

No. 32. Murphy's road (unsafe). New superstructure at once.

No. 34½. On berme east of Rome. New superstructure and abutments; wood.

No. 51. Grove Spring, road. New superstructure.

No. 56. Swing, over old Oneida Lake canal. Is worn out; should be rebuilt or closed.

No. 60. Durkee's road. New superstructure.

No. 70. Beebee's road. New superstructure.

No. 71. Herrick's farm. New superstructure.

No. 79. White roads. New superstructure.

No. 86. Burdick's road. New superstructure (provided for).

One Bridge at DeRuyter. New superstructure.

No. 122. Cold Spring road. New superstructure (provided for).

No. 132. Hamilton farm. New superstructure; can be commuted and abandoned.

Bridges to be Repaired.

No. 2. Starch factory, Utica. West roadway needs replanking (provided for).

No. 20. Yorkville road. General repairs (provided for).

No. 22. Westmoreland street, Whitesboro. General repairs (provided for).

No. 25. Bradley road. General repairs (provided for.)

No. 34. Stanwix road. Replanking.

No. 35. Greenfield road. Iron needle beams should be substituted for the present wooden ones, and the whole floor renewed.

No. 36. DePuyster street, Rome. Replanking.

No. 74. Canaseraga road. Some plank and joists needed.

No. 75. Chittenango road. Rewooding entire.

No. 112. Amboy road. Replanking.

No. 116. Peru road. Replanking (provided for).

No. 120. Main street Jordan. East sidewalk, replanking (provided for).

No. 121. Hamilton street, Jordan. Replanking.

No. 124. Field's, road. West sub-chord (decayed).

No. 130. Brutus street, Weedsport. Sidewalk replanking.

No. 133. Centerport road. West sidewalk replanking.

No. 142. High street foot-bridge, Montezuma. Replanking and steps.

Culverts.

Starch factory culvert at Utica, three arches. Needs some repairs to berme end of west arch. A receiver should be built above the culvert; also a cement wall on berme side of canal.

Culvert under approach to Whitesboro road bridge (No. 19). Should be rebuilt.

Three culverts (composite) between Dunbarton and State road bridges. Foundations should be renewed and masonry relaid (tow-path side).

Composite culvert east of Canaseraga road bridge. Coping on lower breast wall has been rewooded, exposing part of the timber trunk. It should be replaced.

Arch culvert west of Main street, Port Byron. North end of foundation should be renewed and masonry relaid.

Composite culvert west of May's Point. Berme end needs rebuilding.

Feeders.

Oneida feeder. Needs cleaning out the whole length.

Carpenter brook. New valves needed in gates.

Port Byron. Iron pipe has a leak near the road crossing. It does not appear to have materially increased during the year, but should be repaired to prevent further injury to the pipe and waste of water.

Locks.

Nos. 49 and 51. Four new upper gates, one balance beam and one foot bridge are needed in each.

No. 52. One balance beam, one foot bridge, pier at head and general repairs to the machinery. The lock-house needs one new sill.

Waste-Weirs.

At Ballou creek, Utica. New bulk-head.

West of Murphy's bridge. New bulk-head.

Fort Bull. New bulk-head and repairs to masonry.

On berme, west of Happy Valley road bridge. Masonry should be relaid.

The waste-weir at Camillus, on Nine Mile creek, is unsafe and three feet above bottom, consequently sediment which should be discharged through it in high water now passes by and forms bars in the main line of canal. It should be rebuilt so as to discharge at level of canal bottom.

Vertical Walls.

On berme in Utica, from the starch factory culvert to the basin at Broad street, is in a very bad condition and should be relaid.

The masonry of Jamesville reservoir dam, where it connects with the rock at the west end, leaks badly. The filling should be excavated in the rear and the masonry and seams in the rock concreted this fall.

The wooden rack at the head of De Ruyter reservoir has been carried out and should be rebuilt.

OSWEGO CANAL.

Repairs Needed—Bridge Superstructures to be Rebuilt.

No. 5. Wooden stringer bridge over Haskins' race, leading to south side cut, Salina, is dangerous.

No. 6½. Salina street, over south side cut, Salina.

[Assembly, No. 38.]

No. 8. Change bridge, below lock No. 3. (Provided for.)

Clark's feeder bridge (south side cut) is dangerous.

No. 30. Hubbard street, Oswego. (Provided for.)

Sluices, or Tow-path Bridges, to be Rebuilt.

Nos. 2, 4, 5, 8, 11, 17, 22, 34, 35, 36 and 37.

Bulk-heads to be Rebuilt.

Two large bulk-heads at the Varick canal, Oswego. These will require expensive copper dams, and the west one should be finished this fall, as it is unsafe (partly provided for). One large bulk-head to be rebuilt at the Oswego Company's mill-race (partly provided for); also one important bulk-head at the east end of the Fulton dam, between the box factory and lock.

Bridges Needing Repairs.

No. 11. Road and change. Needs new joists.

Three River Point, road and tow-path. Needs replanking.

No. 16. Bridge street, Phoenix. Needs new joists and needle beams.

No. 18. Change at Hinmanville. Needs some new joists.

No. 19. Road at Hinmanville. Needs new joists.

No. 23. Oneida street, Fulton. Wooden needle beams should be replaced with iron.

No. 25. Road and change. Some new plank on tow-path part.

No. 26. Change. New plank and joists.

Minetto road. Replanking.

Sluices or Tow-path Bridges Needing Repairs.

Nos. 3, 9, 13, 18, 26. * Needs replanking.

No. 42. Needs new sides.

Culverts Needing Repairs.

Stone culvert at Liverpool should be pumped out and foundation repaired.

Dams Needing Repairs.

Dam at Baldwinsville, 286 lineal feet, should be rebuilt from low water.

Oswego dam. Apron needs repairs (general).

Copper dam at Battle Island, above bulk-head, should be strengthened.

Docking.

Docking below Three River Point needs new top stick.

Locks.

Baldwinsville side-cut (lower lock), should be rebuilt.

Lock No. 1. Needs one new gate (provided for).

Lock No. 2. Needs one new upper gate.

Lock No. 3. Needs lower mitre sill.

Lock No. 4. (North side-cut). Needs both mitre sills.

Lock No. 5. Needs new docking at foot.

Guard lock No. 1. Needs two upper gates.

Lock No. 6. Needs new docking at foot and two lower gates.

Guard lock No. 3. Needs one upper and one lower gate.

Lock No. 8. Needs two lower gates.

Lock No. 10. Needs two lower gates.

Lock No. 11. Needs new docking at foot.

Guard lock No. 4. Needs two balance beams.

Lock No. 12. Needs two lower gates.

Lock No. 15. Needs two lower gates.

Lock No. 17. Needs two gates (provided for).

Varick canal lock. Needs four new gates.

Piers.

Piers at outlet, Onondaga lake, should be rebuilt.

Retaining Walls.

In rear of tow-path above Hinmanville road bridge, should be rebuilt.

Between locks 17 and 18. Needs repairs.

A new retaining wall should be built at foot of rear slope of tow-path at lock No. 13. The bank is high and has a little quicksand in it, causing slides. The natural slope makes the tow-path too narrow and it will be cheaper to build a low retaining wall than to take out the earth to a slope which will stand. The covered sluice around locks Nos. 1 and 2 (Salina) should be rebuilt from lock No. 1 to Park street.

CAYUGA AND SENECA CANAL.

Repairs Needed — Bridges.

No. 1. Ransom's road. Rebuilding superstructure (provided for.)

Tow-path bridge over river, between locks No. 8 and No. 9, should be rebuilt.

Bridge No. 10. Ovid street, Seneca Falls. Replanking east roadway.

Bridge No. 14. Tow-path over river at Waterloo. Needs rebuilding.

Bridge No. 16. Tow-path over river at Waterloo. Needs rebuilding.

The towing-path bridge over river at Mud Lock, consisting of five spans, should be rebuilt. The stone work of the piers and abutments is displaced from the failure of their pile foundations. Two of the piers are in danger of falling into the river, as only the superstructure keeps them in place. It will require extensive repairs to place this bridge in good condition, and the work should be done at a low stage of water. About forty piles are required for pile fender with new caps attached. The tow-path bridge over junction needs repairs.

Locks.

No. 11. Sides need receiling.

No. 9. Needs two new upper gates.

No. 8. Should be relined.

No. 7. Needs two upper gates. (Ordered at Rochester.)

No. 6. Needs two upper gates and bottom relined. (Would have to be pumped.)

No. 5. Needs two upper gates. (Provided for.)

No. 1. Floor needs some repairs.

Piers.

Pier at Cayuga needs fifty fender piles.

Pier at Geneva needs some new top sticks.

Retaining Wall.

The retaining wall below lock No. 3 should be relaid.

Waste Weirs.

Waste weir above lock No. 6, needs new bulk-head.

Pile Docking.

The pile docking at Geneva has been repaired more or less each year, and should be renewed with crib docking, using old piles for a foundation.

BLACK RIVER CANAL.*Repairs Needed — Locks.*

The masonry of lock No. 29 is so badly crumbled that it has given much trouble and should be taken down and relaid, principally with new stone. Locks Nos. 1, 8, 11, 12, 37, 40, 42 and 60 will soon have to be rebuilt, because of the poor quality of the stone used in their construction. Two or three of the worst ones should be selected for rebuilding each year. The high timber docking at Lyons Falls is being rebuilt above the water line of the river. The timber steamboat lock at Otter creek should be rebuilt above the low water line and one new gate inserted. Beach's lock, a similar structure, was rebuilt in this manner in 1884 and 1885.

Aqueducts.

The roadway to Delta aqueduct should be rebuilt, also one span of the Sugar river aqueduct. Materials should be delivered to repoint the masonry.

Bridges.

Five new bridges over the canal on section No. 2 are required; also new timber approach to bridge at junction of Moose and Black river, at Lyons Falls. Parker's swing is old and should be replaced with an iron superstructure, in fact all the wooden bridges, if they are to be maintained by the State, should be made of iron, when rebuilt. One of the piers and one abutment of the river bridges at Lyons Falls have been badly damaged by the ice, particularly the abutment of the Black river bridge which should be shored up this winter and rebuilt when the water is low. It will be necessary to take down and rebuild one of the piers of the Carthage bridge.

SPECIAL APPROPRIATIONS — BEAVER RIVER DAM AND RESERVOIR.*Chapter 330, Laws of 1886 — Appropriations, \$14,808.03.*

The construction of a tree dam for this reservoir was commenced, under the direction of the Superintendent of Public Works, in the fall of 1885, pursuant to chapter 366, Laws of 1881, and 551, Laws of 1884, and continued until it was found that a

defect in the law would necessitate a suspension of the work. The law of last winter provided sufficient funds and in July the work was resumed under a contract made with Theodore B. Basselin work to be completed on or before November 15, 1886. The work was vigorously prosecuted and is now nearly completed, and will be finished by the time specified. The structure will have a spillway 150 feet long, with the crest nine and one-half feet above ordinary low water. The abutments are cribs filled with stone and gravel, well anchored to the banks of the river. At one end of the dam a bulk-head having three gates, with openings 4x4 feet, will allow the water to be drawn as required to keep a steady flow during the dry season. Modern appliances for manipulating the gates are attached, and in all respects it is considered a well-built and substantial structure for one of its character. The extent of territory that will be flowed has not been definitely ascertained, but it was apparent from preliminary investigations that a capacious reservoir would be made by the erection of this dam. An accurate flow line will be required to determine the quantity of land overflowed and the survey can doubtless be made to best advantage in the winter season.

LENGTHENING LOCKS — ERIE AND OSWEGO CANALS.

Chapter 646, Laws of 1886 — Appropriations: Erie Canal, \$140,000; Oswego Canal, \$60,000.

The law provides for the lengthening of the following locks. The new locks to be same length and width as the present ones:

ERIE CANAL.

- Lock No. 47. To be lengthened at the foot.
- Lock No. 48. To be lengthened at the foot.
- Lock No. 49. To be lengthened at the head.
- Lock No. 51. To be lengthened at the foot.
- Lock No. 52. To be lengthened at the foot.

This includes all on this Division of the Erie, except the guard lock at Utica, No. 46.

OSWEGO CANAL.

- Lock No. 5. To be lengthened at the head.
- Guard Lock No. 1. To be lengthened at the foot.
- Lock No. 6. To be lengthened at the head.

The Erie locks were let July 15th and the Oswego locks August 17th, all to be completed on or before April 15, 1887. Some materials have been delivered at locks 47, 48 and 52, and all preliminary arrangements are actively progressing. The machinery for assisting boats, now in use on the Erie locks, will be remodeled and attached by the Superintendent of Public Works, after the locks are completed.

Stop Gate, near Syracuse.

Chapter 116, Laws of 1886. Appropriation, \$7,000. The bad leak at the tunnel in Syracuse caused considerable apprehension as to the safety of that structure. While the masonry itself is of the best character, the fact that a water course had been formed from the canal around and under the side walls through twenty feet of earth, made it apparent that some precaution should be taken to retain the fifty-six miles of water that lies behind it with a more convenient and nearer located guard gate than had heretofore been provided for. The plan is for a tumble gate, with self-adjusting braces and a bulk-head for feeding purposes. The abutments to be of masonry, placed so as to give a clear opening of forty feet, wide enough for boats to pass each other. Part of the foundation was put in this spring, the law not having been passed in time to do more than this. It will be completed before the canals are opened the coming season.

Cleaning Out State Ditches in Cowassalon Swamps.

Chapter 549, Laws of 1886. Appropriation, \$3,700. This ditch is about eleven miles in length and required the utilization of all the fall that could be obtained to render it effective. The principal work of enlarging and straightening the ditch was done under a former appropriation. The work done this season was principally at the upper and lower ends, where levels taken proved it most needed. The appropriation has been expended, with the exception of a small balance that can be used to advantage if any slides or bars are found after the spring freshets.

Completion of Catharine Street Bridge, Syracuse.

Chapter 205, Laws of 1885. The approaches to this bridge have been completed. The sides are protected by retaining walls, with iron railings attached; stone steps have also been constructed on

the south side. The proper drainage of the street was also provided for.

Vertical Wall, between Stanwix and Thomas Street, Rome.

Chapter 550, Laws of 1886. Appropriation, \$3,000. The work has been let, and is to be completed December 1, 1886.

Road in Onondaga Indian Reservation.

Chapter 330, Laws of 1886. Appropriation, \$2,000. This work has been completed.

State Road at Forestport.

Chapter 330, Laws of 1886. Appropriation, \$500. This work has been completed.

Mentz and Montezuma Ditches.

Chapter 552, Laws of 1886. This work has been completed.

Fishways, Oswego and Seneca Rivers.

Chapter 193, Laws of 1886. Appropriation, \$3,000. No work has been done under this appropriation.

Fishways, Little Salmon River.

Chapter 202, Laws of 1886. Appropriation, \$3,000. Examinations for location have been made, but no work has been done.

Water Record.

The water record of Cayuga and Cross lakes and Seneca river, as per concurrent resolution of 1884, has been regularly taken as required. Following is a complete tabular statement of the record up to the present time :

Water Record of Cayuga and Cross Lakes and Seneca River, as per concurrent resolution of 1884.

[Water surface given below datum line.]

LOCATION.	Bench mark No.	Miles from Cayuga lock.	1884.						1885.						1886.						Remarks.
			AUGUST 5TH, 6TH AND 7TH.		DECEMBER 3D, 3D AND 4TH.		MAR. 4TH, 5TH, 6TH AND 7TH.		AUGUST 6TH AND 7TH.		DECEMBER 2D, 3D AND 4TH.		MARCH 8TH AND 9TH.		AUGUST 5TH, 6TH AND 7TH.						
			Water.		Water.		Water.		Water.		Water.		Water.		Water.						
			Surface	Depth.	Surface	Depth.	Surface	Depth.	Surface	Depth.	Surface	Depth.	Surface	Depth.	Surface	Depth.					
Cayuga lake.....	1	1 1/4	-8.59	10.49	-10.11	8.97	-10.00	9.08	-9.83	9.73	-8.73	10.30	-8.11	10.97	-8.49	10.59	Depth on lock mitre-sill.				
Mud lock.....	2	1 1/4	-8.80	10.42	-10.22	9.00	-10.17	9.05	-9.54	9.63	-8.91	10.31	-8.36	10.96	-8.76	10.46	Depth on mitre-sill.				
Erie canal aqueduct.....	3	6 1/4	-11.42	7.03	-12.98	5.47	-12.66	5.70	-13.19	6.20	-11.26	7.10	-9.72	8.70	-12.12	6.50	Depth on aqueduct found'n.				
Canadawaga river south of Erie canal.....	6 1/4	6 1/4	-11.20	5.60	-12.88	4.00	-12.54	4.60	-11.98	5.20	-11.04	6.10	-9.61	7.60	-11.88	5.40	Depth of river.				
Canadawaga river, north of Erie canal.....	6 1/4	9	-11.58	5.40	-13.01	4.00	-12.83	4.90	-12.48	5.20	-11.48	6.20	-9.93	7.90	-12.24	5.40	Depth of river.				
N. Y. W. S. & B. R. R. crossing.....	4	9	-11.85	3.75	-13.20	2.40	-12.70	2.80	-13.87	2.60	-11.84	3.60	-10.24	5.20	-12.76	2.70	Depth on natural bed.				
N. Y. C. & H. R. R. crossing.....	5	10	-12.41	4.80	-14.19	3.00	-13.48	3.90	-13.48	3.90	-12.66	4.70	-10.74	6.60	-13.81	4.00	Depth on bridge found'n.				
Moosequito point.....	6 15/16	7 25	-15.92	0.10	-16.81	B'd dry	-16.70	B'd dry	-16.04	Dry	-14.23	1.80	-12.15	4.00	-16.28	7.00	Depth on natural bed.				
Cross lake.....	7	25	-17.93	19.20	-17.55	19.00	-18.00	18.50	-17.96	18.70	-15.88	21.10	-14.01	22.50	-17.71	18.80	In channel dredged.				
																	Depth at iron bridge.				

ENGINEERING.

The engineering force have been actively engaged upon ordinary repairs, work in progress under special appropriations and in the preparations of all plans in detail for the locks to be lengthened, and for other work in prospect. They have also submitted maps and data for the Court of Claims and given testimony in important cases. Surveys have been made and maps are in preparation for use at the next session of the court. The work to be done this winter will necessitate a material increase of the force.

All of which is respectfully submitted.

DENISON RICHMOND,

Division Engineer.

STATEMENT showing the names, rank and compensation of Engineers employed on the Middle Division of the New York State Canals, together with the Incidental Expenses, for the fiscal year ending September 30, 1886:

ORDINARY REPAIRS.

Erie Canal.

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond.....	Division engineer.....	Salary...	...	.....	\$2,400 00	\$1,240 00
Denison Richmond.....	Division engineer.....	Travel .....	.....	.....	.....	177 17
H. T. Beach.....	Resident engineer.....	Salary...	.....	.....	2,000 00	30 00
H. T. Beach.....	Resident engineer.....	Travel .....	.....	.....	.....	4 30
David E. Whitford.....	Assistant engineer in charge.....	Salary...	172	\$6 00	.....	1,032 00
David E. Whitford.....	Assistant engineer in charge.....	Travel .....	.....	.....	.....	91 34
R. R. Stuart.....	Leveler	Salary...	166	4 50	.....	747 00
R. R. Stuart.....	Leveler	Travel .....	.....	.....	.....	136 34
Arthur V. Meeker.....	Rodman	Salary...	3	3 50	.....	10 50
Arthur V. Meeker.....	Rodman	Travel .....	.....	.....	.....	7 85
Arthur V. Meeker.....	Chainman.....	Salary...	160	2 50	.....	400 00
Arthur V. Meeker.....	Chainman.....	Travel .....	.....	.....	.....	24 50
						\$3,901 00
<i>Incidental Expenses.</i>						
Stationery.....	.....	.....	.....	.....	\$53 46	
Fuel and light.....	.....	.....	.....	.....	47 92	
Postage and telegraph.....	.....	.....	.....	.....	62 60	
Miscellaneous.....	.....	.....	.....	.....	377 55	
						541 53
Total for Erie canal.....						\$4,442 53-

ORDINARY REPAIRS — (Continued).
Oswego Canal.

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond	Division engineer	Salary	...	...	\$2,400 00	\$348 77
Denison Richmond	Division engineer	Travel	...	...	...	40 77
H. T. Beach	Resident engineer	Salary	...	...	2,000 00	20 00
H. T. Beach	Resident engineer	Travel	...	...	...	1 50
David E. Whitford	Assistant engineer in charge	Salary	10	\$6 00	...	60 00
David E. Whitford	Assistant engineer in charge	Travel	...	...	...	19 77
R. R. Stuart	Leveler	Salary	17	4 50	...	76 50
R. R. Stuart	Leveler	Travel	...	...	...	39 97
Arthur V. Meeker	Rodman	Salary	1	3 50	...	3 50
Arthur V. Meeker	Rodman	Travel	...	...	...	1 50
Arthur V. Meeker	Chainman	Salary	9	2 50	...	22 50
Arthur V. Meeker	Chainman	Travel	...	...	...	23 56
<i>Incidental Expenses.</i>						\$658 34
Miscellaneous	.....	.....	.....	.....	.....	24 00
Total engineering for Oswego canal						\$682 34

Cayuga and Seneca Canal.

Denison Richmond	Division engineer	Salary	...	...	\$2,400 00	\$160 00
Denison Richmond	Division engineer	Travel	...	...	...	11 08
H. T. Beach	Resident engineer	Salary	...	...	2,000 00	25 00
H. T. Beach	Resident engineer	Travel	...	...	...	2 55
David E. Whitford	Assistant engineer in charge	Salary	7	\$6 00	...	42 00
David E. Whitford	Assistant engineer in charge	Travel	...	...	...	13 92
R. R. Stuart	Leveler	Salary	5	4 50	...	22 50
R. R. Stuart	Leveler	Travel	...	...	...	17 98
Arthur V. Meeker	Chainman	Salary	1	2 50	...	2 50
Arthur V. Meeker	Chainman	Travel	...	...	...	9 94
Total for Cayuga and Seneca canal						\$307 47

Black River Canal.

Denison Richmond	Division engineer	Salary	...	...	\$2,400 00	\$300 00
Denison Richmond	Division engineer	Travel	...	...	...	50 49
H. T. Beach	Resident engineer	Salary	...	...	2,000 00	79 79
H. T. Beach	Resident engineer	Travel	...	...	...	14 31
David E. Whitford	Assistant engineer in charge	Salary	17	\$6 00	...	102 00
David E. Whitford	Assistant engineer in charge	Travel	...	...	...	37 81
R. R. Stuart	Leveler	Salary	11	4 50	...	49 50
R. R. Stuart	Leveler	Travel	...	...	...	44 30
Total for Black River canal						\$678 20

SUMMARY of engineering expenses upon Ordinary Repairs, for the fiscal year ending September 30, 1886:

Erie canal	\$4,442 53
Oswego canal	682 34
Cayuga and Seneca canal	307 47
Black River canal	678 20
Total engineering for ordinary repairs	\$6,110 54

EXTRAORDINARY REPAIRS.

Engineering expense for lengthening locks on the Erie and Oswego Canals, for the fiscal year ending September 30, 1886. (Act chapter , Laws of 1886.)

Erie Canal.

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond	Division engineer	Salary...	...	...	\$2,400 00	\$100 00
H. T. Beach	Resident engineer	Salary...	...	...	2,000 00	158 90
H. T. Beach	Resident engineer	Travel .....	...	...	...	1 25
David E. Whitford	Assistant engineer in charge	Salary...	73	\$6 00	...	438 00
David E. Whitford	Assistant engineer in charge	Travel .....	...	...	...	16 29
R. R. Stuart	Leveler	Salary...	65½	4 50	...	294 00
R. R. Stuart	Leveler	Travel .....	...	...	...	14 52
Arthur V. Meeker	Rodman	Salary...	56	3 50	...	196 00
Arthur V. Meeker	Chainman	Salary...	78	2 50	...	195 00
Arthur V. Meeker	Chainman	Travel .....	...	...	...	1 82
Laurence L. Gaul	Rodman	Salary...	14	3 50	...	49 00
Laurence L. Gaul	Rodman	Travel .....	...	...	...	1 87
John C. Brady	Chainman	Salary...	14	2 50	...	35 00
John C. Brady	Chainman	Travel .....	...	...	...	1 48
<i>Incidental Expenses.</i>						\$1,503 13
Stationery					\$43 97	
Miscellaneous					26 91	
Total for Erie canal						\$1,574 01

Oswego Canal.

H. T. Beach	Resident engineer	Salary...	...	...	\$2,000 00	\$158 91
H. T. Beach	Resident engineer	Travel .....	...	...	...	7 48
David E. Whitford	Assistant engineer in charge	Salary...	24	\$6 00	...	144 00
David E. Whitford	Assistant engineer in charge	Travel .....	...	...	...	9 10
R. R. Stuart	Leveler	Salary...	159½	4 50	...	84 00
R. R. Stuart	Leveler	Travel .....	...	...	...	12 97
Total for Oswego canal						\$416 46

Summary.

Erie canal	\$1,574 01
Oswego canal	416 46
Total engineering for lengthening locks	\$1,990 47

EXTRAORDINARY REPAIRS — (Continued).

Engineering expenses constructing a "Stop Gate" on the Rome level of the Erie Canal, just east of Syracuse. (Act chapter , Laws of 1886.)

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond	Division engineer	Salary...	...	.....	\$2,400 00	\$100 00
R. R. Stuart.....	Leveler	Salary...	2	\$4 50	.....	9 00
R. R. Stuart.....	Leveler	Travel...	...	.....	.....	2 00
<i>Incidental Expenses.</i>						\$111 00
Miscellaneous.....						8 00
Total engineering for stop gate.....						\$119 00

Engineering expenses cleaning ditches in Cowassalon Swamp. (Act chapter 549, Laws of 1886.)

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
H. T. Beach.....	Resident engineer	Salary...	...	.....	\$2,000 00	\$27 40
H. T. Beach.....	Resident engineer	Travel...	...	.....	.....	6 62
A. P. Clark.....	Assistant engineer.....	Salary...	70	\$5 00	.....	350 00
A. P. Clark.....	Assistant engineer.....	Travel...	...	.....	.....	85 81
Laurence L. Gaul.....	Rodman	Salary...	56	3 50	.....	196 00
Laurence L. Gaul.....	Rodman	Travel...	...	.....	.....	25 81
John C. Brady.....	Chainman.....	Salary...	56	2 50	.....	140 00
John C. Brady.....	Chainman.....	Travel...	...	.....	.....	25 81
Total engineering for Cowassalon ditch.....						\$857 45

Engineering expenses, construction of the Beaver River Dam. (Act chapter 330, Laws of 1886.)

NAMES.	Rank.	Salary or travel.	No. of days.	Rate per day.	Rate per year.	Total amount.
Denison Richmond	Division engineer	Salary...	...	.....	\$2,400 00	\$151 23
Denison Richmond.....	Division engineer	Travel...	...	.....	.....	119 95
David E. Whitford	Assistant engineer in charge	Salary...	10	\$6 00	.....	60 00
David E. Whitford	Assistant engineer in charge	Travel...	...	.....	.....	50 30
R. R. Stuart.....	Leveler.....	Salary...	14	4 50	.....	63 00
R. R. Stuart.....	Leveler.....	Travel...	...	.....	.....	33 70
F. N. Kimball	Leveler	Salary...	65	4 50	.....	292 50
F. N. Kimball	Leveler	Travel...	...	.....	.....	10 27
James Shanahan, Jr.	Chainman	Salary...	45	2 50	.....	112 50
James Shanahan, Jr.	Chainman	Travel...	...	.....	.....	19 04
Arthur V. Meeker	Chainman	Salary...	5	2 50	.....	12 50
Arthur V. Meeker	Chainman	Travel...	13 90
Total engineering for Beaver River Dam.....						\$938 89

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